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THE AMERICAN JOURNAL OF ROENTGENOLOGY
RADIUM THERAPY AND NUCLEAR MEDICINE

VOL. 70 DECEMBER, 1953 No. 6

THE ROENTGEN ASPECTS OF THE CONGENITAL ANOMALIES IN THE UMBILICAL REGION*

By ROBERT M. LOWMAN, M.D., LEVIN L. WATERS, M.D., *and* HOWARD W. STANLEY, M.D.

NEW HAVEN, CONNECTICUT

INTRODUCTION

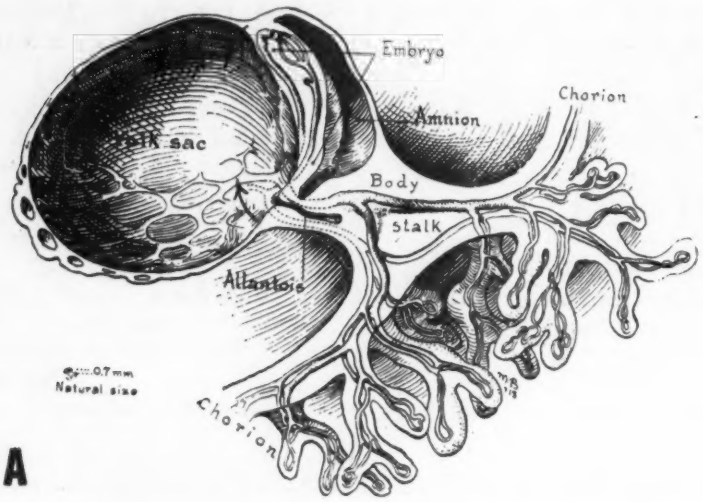
IT IS a remarkable provision of nature that such constancy is obtained in the development of the normal structures of the alimentary and urinary tracts despite the complex changes which occur during the maturation of these fetal structures. That the intricate maturation of these systems is occasionally disturbed resulting in local congenital deformities is therefore not surprising. These anomalies are found principally in children and include the congenital deformities of the omphalomesenteric duct, the anomalies of the urachus and omphalocele. Moreover, since these uncommon disorders of the umbilicus are amenable to surgical repair and correction, they are of great interest to the surgeon. Because of the rarity of these conditions and the problems associated with their differential diagnosis and the almost complete lack of such comparative studies in the roentgenographic literature, it was felt proper to summarize this material.[37]

In the following presentation, no effort has been made to discuss in detail all of the various anatomic aberrations which have been observed in the region of the umbilicus.

The rare congenital anomalies which require a differential diagnosis and have some possibility of surgical correction will be stressed. Thus, it is our contention that simple roentgenological studies provide an easy, safe and accurate method for establishing a differential diagnosis of the developmental anomalies involving the patent omphalomesenteric duct and the patent urachus. Moreover, such procedures will aid in evaluating the variations of these anomalies. Intentional omission of certain uncommon lesions in the region of the umbilicus is noted. Thus, endometriosis which occurs mainly in adults and may be of clinical significance is not discussed. Occasionally, extrophy of the bladder involves the umbilicus but this lesion is only of secondary importance in this presentation. Persistence of the omphalomesenteric vessels producing vascular anomalies of clinical significance is rarely reported.

The clinical data utilized in this report

* From the Departments of Radiology and Pathology of the Grace-New Haven Community Hospital, The Memorial Unit, and the Yale University School of Medicine.



A

FIG. 1(*A*). Sagittal Section Showing a Very Early Stage in the Formation of the Umbilicus and Allantois. (Human embryo, 0.7 mm. long.) Note the origin of the allantois from the cavity of the yolk-sac. The umbilical region will be formed by a gradual approximation of the cranial and caudal ends of the yolk-sac, as indicated by the arrows. The embryonic surface of the yolk-sac will later become the alimentary canal.

were taken from the records of patients reviewed in the Department of Radiology of the Grace-New Haven Community Hospital, The Grace Unit, during the period 1945 to 1950. During this period, 2 patients with complete patency of the omphalomesenteric duct were seen. During the same period, 2 additional patients with patent urachi were encountered. The problems in differential diagnosis presented by these cases prompted a study of these anomalies.

To appreciate the malformations involving the umbilicus which may result from persistent remnants of the vitelline duct, the allantois, and the vascular structures in this area, it is well to classify these congenital anomalies. The classic volume by Cullen[10] in 1916 has reviewed this detail most admirably. A simple classification has been devised by Trimingham *et al.*[43,44]

I. Alimentary anomalies.
   - A. Completely patent omphalomesenteric duct (umbilical enteric fistula).
   - B. Partially patent omphalomesenteric duct.
     1. Peripheral portion (umbilical sinus).
     2. Intermediate portion (vitelline cyst).
     3. Enteric portion (Meckel's diverticulum).
   - C. Mucosal remnant at the umbilicus (umbilical polyp).
   - D. Congenital band (obliterated omphalomesenteric duct).

II. Urachal anomalies.
   - A. Completely patent urachus (umbilical urinary fistula).
   - B. Partially patent urachus.
     1. Peripheral portion (umbilical urachal sinus).
     2. Intermediate portion (urachal cyst).
     3. Vesicle portion opening into the bladder.

III. Vascular anomalies.
   - A. Persistent omphalomesenteric vessels.
   - B. Persistent umbilical vessels.
   - C. Persistent urachal vessels.

IV. Somatic anomalies.
   - A. Congenital umbilical hernia.
   - B. Extrophy of the bladder.
   - C. Endometriosis of the umbilicus.

EMBRYOLOGY

In order to evaluate the anomalies noted above and to distinguish them from other lesions important in differential diagnosis, some knowledge of the intricate embryology of this region should be presented. This will be given in two main sections dealing with the formation of the (1) omphalomesenteric duct and (2) the allantois and its relationship to the urachus. These changes are excellently portrayed in the illustrations created by Broedel,* Figures 1 to 5, which were published in Cullen's book.[10] So that the gradual development of

* The Broedel drawings and the accompanying legends have been reproduced here through the kind permission of the W. B. Saunders Company, Philadelphia.

the umbilicus may be understood, it is necessary to begin with the description of a very young embryo. The greater portion of a 1.5 mm. embryo consists of extra-embryonic membrane, namely, the chorion, the amnion and the yolk sac (Fig. 1*A*). The early embryo itself at this time is represented by the embryonic plate which consists of an ectodermal disc and the margins of the disc are continuous with the amnion. The amnion forms a hood over the embryonic plate and is also ectodermal in character.

The primitive endodermal vesicle or yolk sac forms a sac-like structure ventral to the embryonic plate (Fig. 1*B*). The embryonic plate separates the amnion and the yolk sac, all of which are situated in the large cavity of the primitive blastocyst. The wall of the blastocyst contributes to the formation of a chorionic cavity. The chorion, amnion and yolk sac, though important in the protection and nourishment of the developing embryo, are shed at birth. Suspended from the inner aspect of the chorionic cavity is the pedicle of the body stalk; the mesenchyma of the body stalk continues over the surfaces of the yolk sac and amnion and completely envelopes these structures. Since the mesenchyma is also insinuated between the embryonal plate and the endoderm of the yolk sac, the three principal germ layers—the ectoderm, endoderm and the mesoderm—are intimately associated at the site of the embryonal plate. The cavity of the chorionic vesicle which forms the primitive or extra-embryonic celomic cavity is bounded by this epithelial layer called mesothelium.

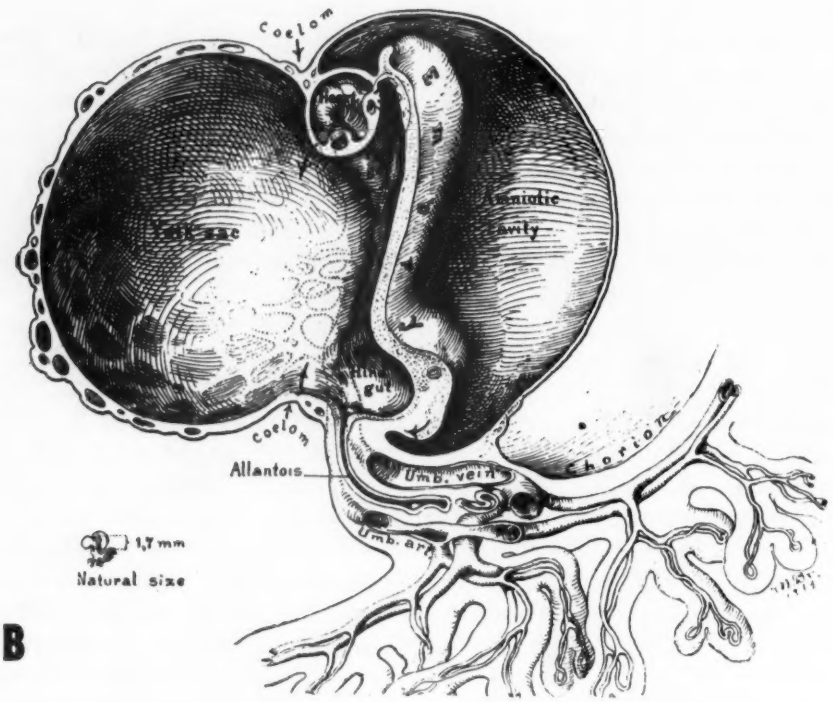
By the time the embryo is five weeks old and is approximately 6 millimeters long, the amnion has almost completely enveloped the well developed embryo. The amnion, however, does not cover a small circular area at which the yolk sac and body stalk enter the true embryo. At the margin of this circular area which will form the future umbilicus, the embryonal ectoderm becomes continuous with the amniotic ectoderm (Fig. 1*C*).

Simultaneously, the endodermal yolk sac also demonstrates certain developmental features. The portion of the vault of the yolk sac which lies on the ventral aspect of the embryonal plate is the primordium of the future digestive tract. With the enveloping action of the amnion and the formation of the head and tail folds, the wide communication between the yolk sac and the developing gut is gradually reduced. By the time the embryo is 6 mm. long, this communication is represented by an elongated tubular structure which is the omphalomesenteric or vitelline duct (Fig. 2).

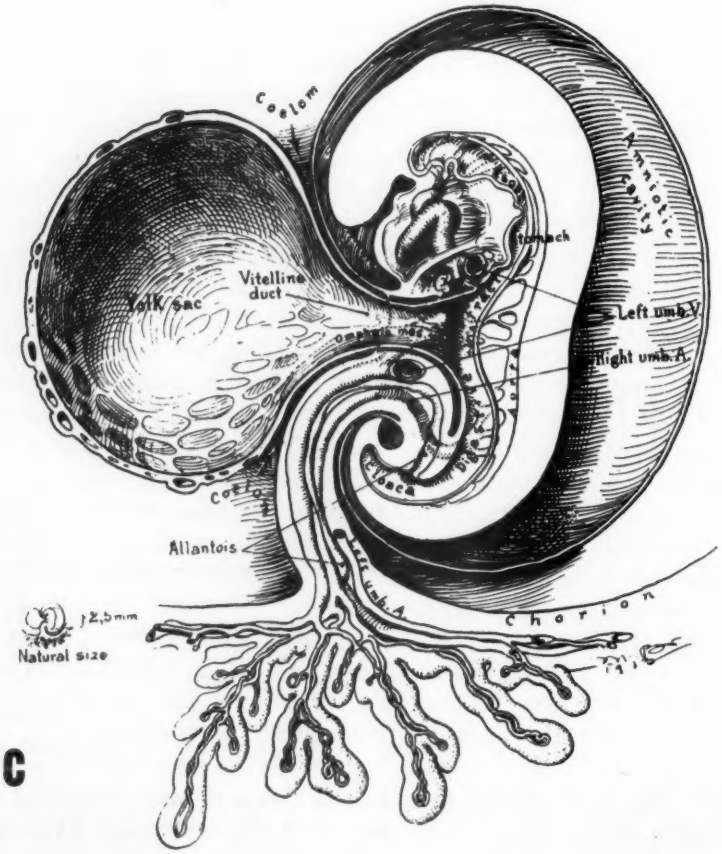
With the additional growth of the amniotic cells, the omphalomesenteric duct and the body stalk, which enter the ventral surface of the embryo, are elongated and pressed closely together. Finally, the amnion envelopes the tube which contains the omphalomesenteric duct and body stalk and with these structures forms a tubular organ which connects and suspends the embryo from the inner aspect of the chorion.

This complex tubular structure is the umbilical cord. The yolk sac and the omphalomesenteric duct are situated within the cavity of the chorionic vesicle or the exocelom (extra-embryonic celom). The intra-embryonic celom, or celom proper, forms the true body cavity. Within this intra-embryonic celom, the growing intestinal tract is situated. This body cavity communicates through the umbilicus with a portion of the extra-embryonic celom which has been folded into the umbilical cord along with the narrowed yolk sac and omphalomesenteric duct (Fig. 3).

Passing from the convexity of the primordium of the bowel is the omphalomesenteric duct which is still visible at this stage. With embryonic development, the bowel is extruded transiently from the extra-embryonic celom into the umbilical stalk. When the embryo has attained the size of 30 mm., almost all of the intestines are situated in the cord (Fig. 4). There is, however, a later recession of all of the intestinal loops into the celomic cavity and by the time the embryo is 45 mm. long, this


Coelom
Amniotic cavity
Yolk sac
Vitelline duct
Coelom
Allantois
Umb. vein
Chorion
Umb. art.
1,7 mm
Natural size

B


Coelom
Amniotic cavity
Stomach
Vitelline duct
Yolk sac
Left umb.V
Right umb.A.
Placenta
Allantois
Chorion
2,5 mm
Natural size

C

withdrawal is normally complete (Fig. 5).

Ahlfeld[1] has suggested that omphalocele is caused by the persistence of the omphalomesenteric duct which anchors the intestine in the umbilical cord and does not permit the normal return of the intestinal loops.

Most observers believe that the defect is due to the development of the abdominal viscera at a more rapid rate than the abdominal cavity. The persistence of the disproportion in size between the abdominal viscera and the retarded development of the abdominal cavity prevents return of all or a part of the primitive intestine from the celom of the umbilical cord. This produces the condition termed omphalocele, exomphalos, amniotic hernia or eventration of the umbilicus. The contents of the protrusion may vary from slight bulging of the omentum at the navel to a complete protrusion of all of the primitive intestinal loops.

The external covering of all omphaloceles is not skin but amniotic membrane similar to the covering of the umbilical cord. This tissue paper thin translucent amniotic membrane fuses with the skin at the umbilical margins. Various individuals have stressed, as a rule, that a true sac is not present since the peritoneal covering stops at the umbilical ring.[3] Careful ligation of the cord in the presence of an omphalocele is necessary to make certain that no important structures have been tied off by the ligature.

The obliteration of a portion or none of this omphalomesenteric duct produces a number of anomalies, the commonest of which is the type of diverticulum originally described by Meckel.[33] Normally, the omphalomesenteric duct existing as a patent communication between the small bowel primordium and the yolk sac is short lived. As a rule, this communication with the small bowel disappears and the remnant of the duct is represented by a solid cord.

The allantois is derived from that portion of the yolk sac which subsequently forms the hind gut and later the ventral cloaca (Fig. 3 and 4). This finger-like process is directed into the body stalk terminating in a small sac-like extension. In the lower animals, the sac-like extension acts as a container for certain waste products and is considered a primitive urinary bladder. In man, the allantois performs no essential functions and remains a vestigial structure.

In 1927 and 1930, Begg[4] tabulated the cases of the literature and completed exhaustive studies of the anatomy, histology

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Fig. 1(*B*). A More Advanced State in the Formation of the Umbilical Region. (Human embryo, 1.7 mm. long. Mall series, 391.) (This embryo has been very carefully described by Dr. Walter E. Dandy (Amer. Jour. Anat., 1910, x, 85.) Note the advancing approach of the cranial and caudal portions of the yolk-sac and its division into a main cavity and two recesses, the fore-gut and the hind-gut into the latter of which the allantois now opens. The vitelline arteries and veins are clearly seen on the embryonic side of the yolk-sac. The amnion is now gradually enveloping the embryo. Compare the situation of the coelom in this with that in the subsequent pictures. There is as yet no umbilical cord. For the first stage of its development, see Fig. 1*C*.

Fig. 1(*C*). A Composite Picture Showing the Formation of the Umbilicus in an Embryo 2.5 mm. long. This drawing was made after a careful study of several embryos of this length described in the literature. Each author was interested in some particular region, but not in the embryo as a whole. The yolk-sac has not become greatly narrowed at its entrance into the body. The narrowed portion is now referred to as the vitelline or omphalomesenteric duct. In its wall are seen the right omphalomesenteric vessels. The digestive tract already shows well defined differentiation. The allantois now opens into the cloaca. The amnion almost completely encircles the embryo, and is so doing has combined the vitelline duct with the body stalk, containing the chorionic vessels and the allantois, into a common cord. As the development advances this cord will become more compact, thinner and longer. The exocoelom has been drawn into the embryo and will later unite with the coelom of the pleuroperitoneal cavity.

(Figure 1, *A*, *B* and *C* are reproduced through the kind permission of W. B. Saunders Company from "Embryology, Anatomy and Disease of the Umbilicus" by T. S. Cullen. W. B. Saunders Co., Philadelphia, 1916.)

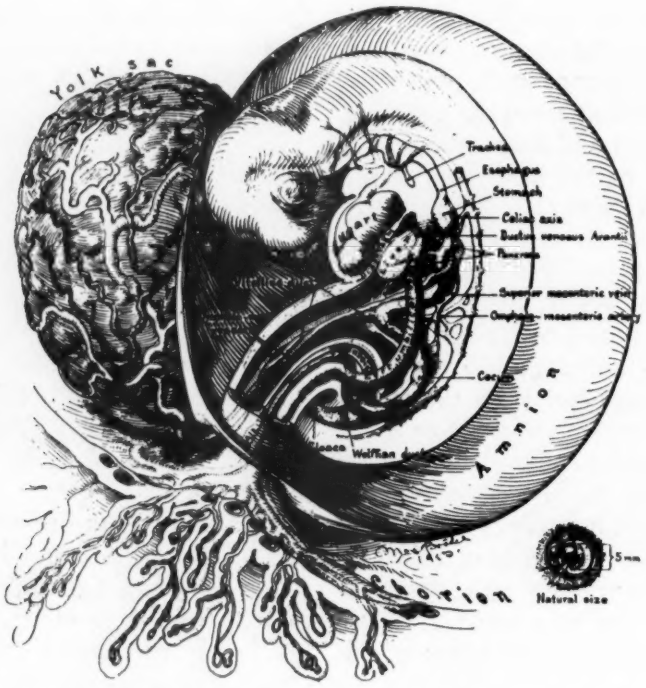


FIG. 2. Sagittal View of a Human Embryo 5 mm. in Length. In large part the left halves of the amnion and embryo have been removed, in order to bring clearly into view the structure of the cord. The expanding amnion has almost reached the chorion, hence but little remains of the extra-amniotic portion of the yolk-sac and of the body stalk. The umbilical cord has become longer. The caudal portion of the cord is firm and contains the umbilical arteries and veins; the latter, soon after leaving the body, form a common trunk, which usually curves toward the left. Between the two umbilical arteries lies the allantois, the bulbous end of which still persists almost to the amnion. The cranial portion of the cord is looser in texture. It contains the coelomic cavity, in which lies the omphalomesenteric duct, accompanied by its vessels. Note that the superior mesenteric vein empties into the omphalomesenteric vein behind the pancreatic buds. The omphalomesenteric artery still arises by several branches from the aorta. (Reproduced through the kind permission of W. B. Saunders Company from "Embryology, Anatomy and Disease of the Umbilicus" by T. S. Cullen. W. B. Saunders Co., Philadelphia, 1916.)

and the development of the urachus in human embryo. Begg challenged that the allantois contributed to the formation of the fundus of the bladder and that the remnant of the allantois persisted as a cord-like structure forming the urachus which connected the apex of the bladder to the umbilicus.

Instead, Begg stated that the allantois should be considered as a true vestigial structure and that it contributed nothing to the formation of the bladder or urachus. It was his opinion that the bladder is derived from the endoderm of the ventral cloaca except for a small segment which arises from the mesonephric ducts. This cloaca grows upward, extending to the level of the umbilicus, forming what may be considered a primitive urinary bladder. The portion of the allantois which is contained in the embryonal portion of the body stalk in most cases disappears. A section of the conical apex of the ventral cloaca narrows, and this atrophied segment which extends downward from the umbilicus forms the urachus. Following birth, the normal descent of the bladder into the pelvis drags the urachus free from the umbilicus. According to Begg, the urachus itself is only 5 cm. long and usually its peripheral end is about 12 cm. from the umbilicus.

While controversy still exists concerning the development of the urachus, Ham-

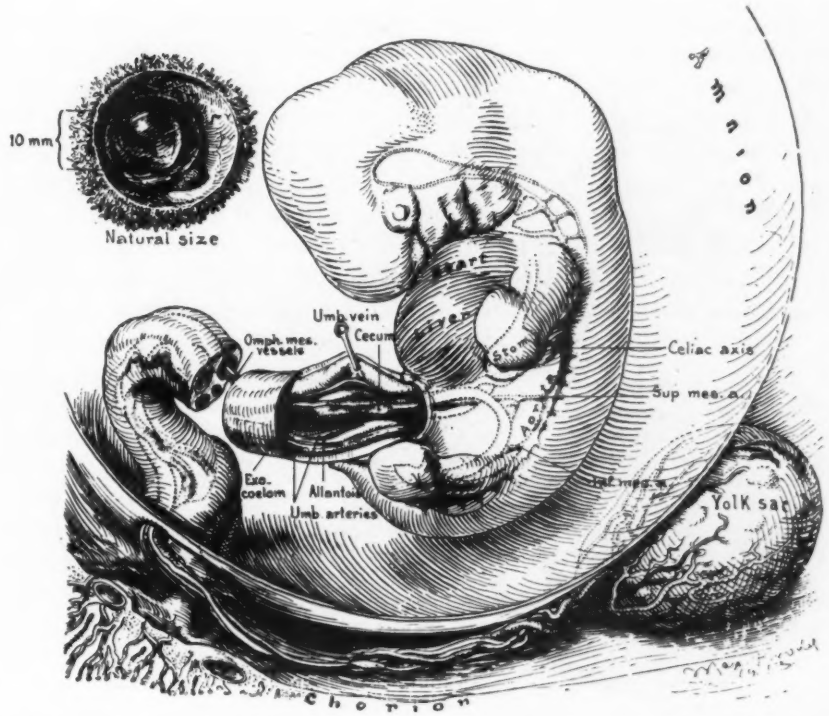


Fig. 3. Sagittal View of the Umbilical Region of a Human Embryo 10 mm. in Length. The yolk-sac now lies far removed from the umbilical cord; its vessels and stalk follow a tortuous course. The umbilical cord here shows the first indication of a twist, which may be caused by the embryo rotating toward the right. In the embryos examined by us there has been but one exception to this rule. The small intestine extends a considerable distance into the exocoelom of the cord. At the outer end of the intestinal loop is situated the delicate omphalomesenteric duct. The omphalomesenteric vein passes on the left side of the intestinal loop; the artery, on the right side. (Reproduced through the kind permission of W. B. Saunders Company from "Embryology, Anatomy and Disease of the Umbilicus" by T. S. Cullen. W. B. Saunders Co., Philadelphia, 1916.)

mond, Yglesias and Davis[23] have offered substantial evidence that the normal urachus can extend to the umbilicus in the adult. Other investigators suggest that the allantoic diverticulum forms the primitive urinary bladder early in embryonic life.[10]

The investigators who differ with Begg suggest that the urachus within the umbilical cord joins the urinary bladder, and that the time of urachal obliteration is variable. According to Cullen,[10] the urachus has a tendency toward dilatation at regular intervals. At the best, it must be stated that the development of the urinary bladder, the fate of the allantois and the role of the urachus are still controversial.

It was Begg's belief that the urachal canal was never completely obliterated. In a third of his specimens he was able to demonstrate a communication between the urachal lumen and the bladder. Although patent, the lumen of the urachus is usually tiny and may become plugged with desquamated cells.

Because of their importance in diagnosis, the other structures which develop in the umbilical region should be reviewed. The fine network of blood vessels which supply the yolk sac and the young embryo converge to form two omphalomesenteric arteries and two omphalomesenteric veins. While the right persists as a fair sized vessel accompanying the omphalomesenteric duct through the umbilical cord, the left omphalomesenteric artery disappears. Later, the right artery normally disappears except that portion which is destined to become the superior mesenteric artery.

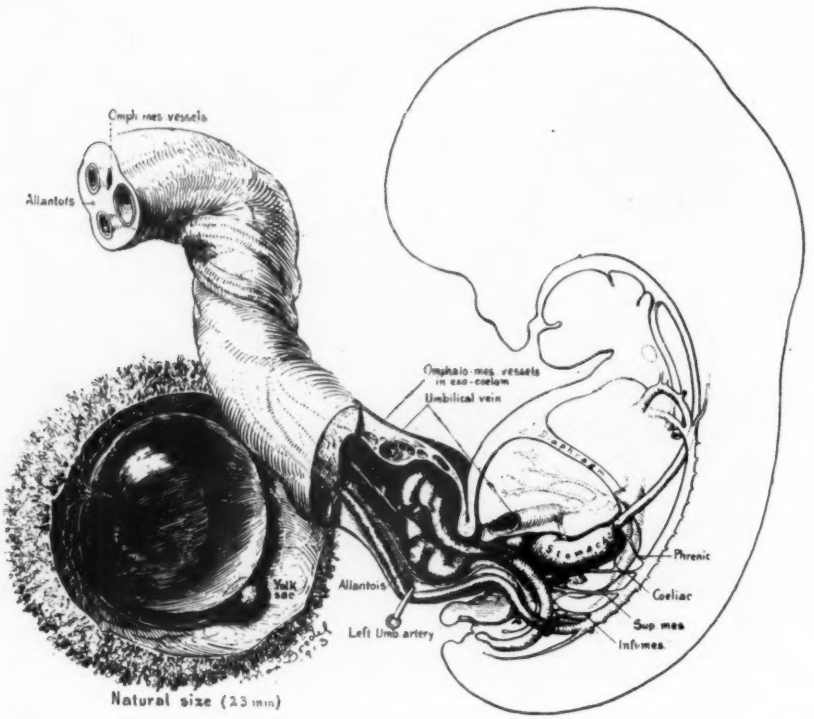


FIG. 4. Sagittal Section of the Umbilical Region in a Human Embryo 23 mm. in Length. The small drawing to the left, which is of natural size, accurately depicts the relation of the yolk-sac to the cord and amnion. Its stalk is very long, and the yolk-sac has become relatively smaller. The umbilical cord now shows very marked twisting. The exocoelomic cavity in the umbilical cord now contains practically all the intestine with the exception of the jejunum and descending colon. The distal portion of the cavity is funnel-shaped, the apex being directed away from the embryo. The omphalomesenteric duct has disappeared, but its vessels persist. The small cystic spaces in the upper wall of the cord mark the beginning obliteration of the exocoelom. The umbilical vein has been partly removed in order to bring into view the deeper structures. The two umbilical arteries, accompanied by the allantois, are in their usual position in the lower part of the cord. Note the slight spindle-shaped dilatation of the allantois in its course. (Reproduced through the kind permission of W. B. Saunders Company from "Embryology, Anatomy and Disease of the Umbilicus" by T. S. Cullen. W. B. Saunders Co., Philadelphia. 1916.)

Similarly, the two omphalomesenteric veins disappear before birth except the proximal portion of one which subsequently becomes the portal vein.[17]

Two umbilical arteries and two veins which extend from the placenta to the embryo are also formed. The two arteries persist until birth, subsequently forming the obliterated branches of the hypogastric arteries. Though one of the umbilical veins disappears quite early, the other functions as the umbilical vein until birth, subsequently forming the ligamentum teres of the falciform ligament. The urachal artery arising from the superior vesicle branch of the left hypogastric artery extends along the ventral aspect of the urachus. It courses into the cord to supply the allantois. This artery is ordinarily obliterated at birth producing a small fibrous cord lying in close relationship to the urachus.

Four main groups of congenital anomalies may occur in the umbilical area, depending upon the system chiefly involved in the development of these anomalies. Brief discussions of anomalies which are not strictly umbilical in the anatomic sense, such as Meckel's diverticulum and urachal cyst, are included. While these are removed anatomically from the umbilicus, they are embryologically related to the umbilical aberrations.

Numerous observers have already pointed out that one of the rarest of all anomalies is a completely patent omphalomesenteric duct representing a true fistula between the bowel and the umbilicus. Meckel's diverticulum and a patent omphalomesenteric duct result from the same defect in embryonic development varying only in the extent to which the omphalomesenteric duct fails to obliterate. Meckel's diverticulum, however, is found relatively frequently, occurring in approximately 1 to 2 per cent of individuals.

Kittle, Jenkins and Dragstedt[27] listed reports of 131 cases of patent omphalomesenteric duct, including 2 of their own. These observers reviewed 2 cases with complete patency of the omphalomesenteric duct treated at the University of Chicago Clinics. These 2 cases occurred in 30,000 births at the Chicago-Lying-In Hospital at the University of Chicago. Ferris and Putnam[15] added 5 additional cases, which were not included in the review by Kittle *et al.*,[27] and recorded 2 additional cases from the Mayo Clinic. Additional cases were recorded by Arnheim,[3] Fox,[16] Minor,[34] and Kirtland[26] in 1951. Cullen was able to collect and report a total of 46 cases.

Because of the relationship between patent omphalomesenteric duct and Meckel's diverticulum, the contributions made by Johann Frederich Meckel are significant. This observer proposed the following items in a group of three papers published between 1808 and 1815.[32,33] He believed that the diverticulum represented an incomplete disappearance of the proximal segment of the omphalomesenteric duct. He considered the obliterated umbili-

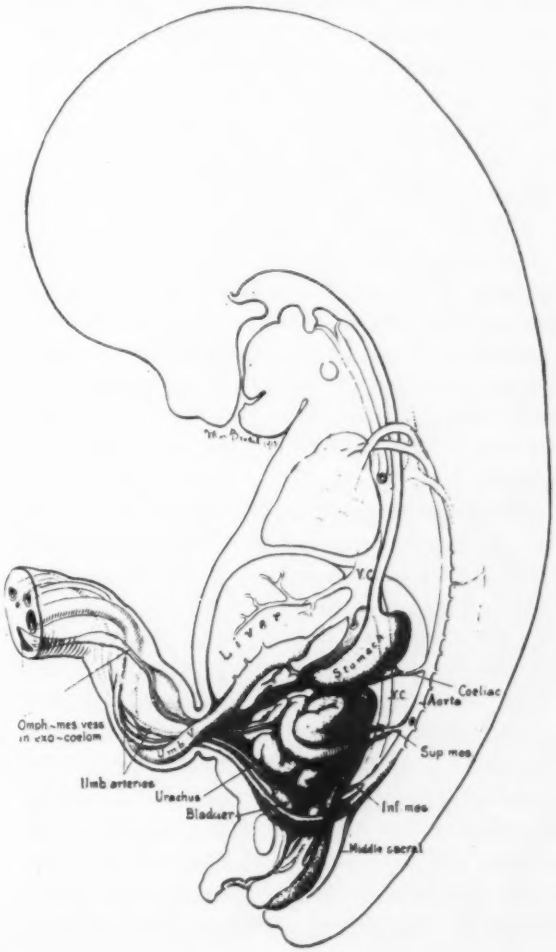


Fig. 5. Sagittal Section of the Umbilical Region in a Human Embryo 4.5 cm. in Length. The intestine has receded completely into the abdominal cavity. The exocoelomic cavity, although small in size is still clearly recognizable in the cord, where it shows spindle-shaped dilatations. It now contains only the omphalomesenteric vessels, which have become embedded in its wall. The allantois (urachus) is the distal prolongation of the urinary bladder, and shows already the characteristic dilatations noticeable in older embryos and occasionally found after birth. The structures of the cord show the characteristic twisting of the embryo to the right. (Reproduced through the kind permission of W. B. Saunders Company from "Embryology, Anatomy and Disease of the Umbilicus" by T. S. Cullen. W. B. Saunders Co., Philadelphia, 1916.)

cal vessels which persisted as fibrous strands between the umbilicus and the diverticulum as a basis for his theory of origin.

The diverticulum was congenital, situated in the ileum at the site where the original yolk stalk connected between the gut and the yolk sac. Moreover, the diverticulum was solitary and situated in the antimesenteric portion of the bowel. Since the first reported case of a patent omphalomesenteric duct by Poussin[39] in 1817, Meckel's work and explanations and its significance in the genesis of abdominal pathologic conditions have been stressed.

The cases of patent omphalomesenteric duct which are available in the literature have been reviewed and summarized by Kittle *et al.*[27]

These authors presented the groups of uncomplicated omphalomesenteric ducts and listed the cases in which the condition was complicated by a prolapse of the intestine through the umbilical fistula. Some of the cases in the literature have been characterized by unusual features. The case presented by Crymble[9] was of interest since the omphalomesenteric duct appeared to originate from the appendix. Similar cases have also been presented by Hadley and Cogswheel,[22] and Walthard.[46] The cases reported by Garratt[18] occurred in twins who were thought to be of the homologous type. Recognition of a patent omphalomesenteric duct because of the escape of intestinal worms in the umbilicus has also been reported.[39]

Most authors note the preponderance of the occurrence of patent omphalomesenteric duct in males. Thus, in the uncomplicated cases presented by Kittle *et al.*, 74 of the patients were males, 17 were females, and in 13 cases the sex was not listed. In their collection of 27 cases in which the patent omphalomesenteric duct was complicated by prolapse, 19 of the patients were males and only 1 patient was a female. The sex of the other infants in this group was not given. The association of other anomalies with the umbilical deformities has been noted by numerous other authors. Thus, various investigators have presented cases in which portions of the omphalomesenteric vascular structures could be recognized. Other authors have recorded cases in which portions of the urachus could also be demonstrated. In the cases in which microscopic examination of the tissues from the umbilicus and the omphalomesenteric duct could be examined, an incidence of approximately 18 per cent of heterotopia is mentioned. While all types of gastric mucosa have been found in the region of the umbilicus, ectopic small intestine and colonic mucosa have also been described.

Other malformations have been observed concomitantly in association with anomalies of the omphalomesenteric duct and Meckel's diverticulum. Meckel, in his early description, noted the association of this anomaly in patients with harelip, cleft palate, bicornuate uterus, spina bifida and anencephaly. In one-third of the cases entered by Christie[7] instances of microgyria, microcephaly, laryngeal stenosis, esophageal atresia, ureteral anomalies and congenital cardiac conditions were associated with abnormalities of the omphalomesenteric duct. In half of this author's cases, there were associated umbilical hernias. Christie[7] noted that 80.9 per cent of the malformations were found in males and he stated that the coincidence of the other anomalies is offered as evidence of a defective germ plasm as an etiological feature. Whether the persistence of the vitelline duct and its failure to obliterate completely represents normal development or a localized aberration in development or or is a part of the generalized systemic disturbance of growth remains to be answered. Since Meckel's diverticulum occurs so frequently in a large group of normally accepted individuals this would indicate that there is no systemic or diffuse abnormal embryonic development.

Kittle, Jenkins and Dragstedt have suggested that the low rate of occurrence of Meckel's diverticulum noted in a large series of autopsies performed at the University of Chicago would suggest that

Meckel's diverticulum is an irregularity in localized growth rather than a generalized disturbance.

Cullen reviewing the material in his volume also noted the prevalence of the condition in males. In the 35 cases which this author collected, 22 were found in individuals under one year, 8 cases were in patients between one and ten years of age and 5 cases were noted in individuals ten years of age and over.

An abnormality of the cord at birth, more frequently noted in male infants associated with some drainage and the appearance of a reddish mass in the umbilicus following the sloughing of the cord structures are findings suggestive of a patent omphalomesenteric duct. These findings together with fecal drainage are indeed indicative of such a lesion. The umbilical depression in such cases is occupied by a bright red nodule when the cord has sloughed away. This nodule may vary in size from that of a pea to the size of a hazelnut. In other cases, the diameter may be greater and it may assume snout-like proportions. Reports of cylindrical and sausage tumor-like extensions ranging in size up to 1½ to 2 inches have been reported. Actually, the appearance of the umbilical protrusion will depend upon how far from the abdominal surface the cord has ligated.

In the cases where the cord is thicker, the ligature is applied away from the umbilical base. In such cases, a larger segment of the omphalomesenteric duct will be left behind. This will account for the size of the protrusions seen. In other cases, larger flat polypoid areas of mucosa are found. The soft velvety nodule which is covered with an intestinal type of mucosa may also show gastric or pancreatic tissue. The umbilical depression at the summit of this nodule reveals an opening of varying size from which some drainage may be noted. The drainage from the opening will vary depending upon the size of the opening. At times, clear mucoid material will be found. At times, the size of the opening in the cord may be so large as to permit escape of large amounts of fecal material.

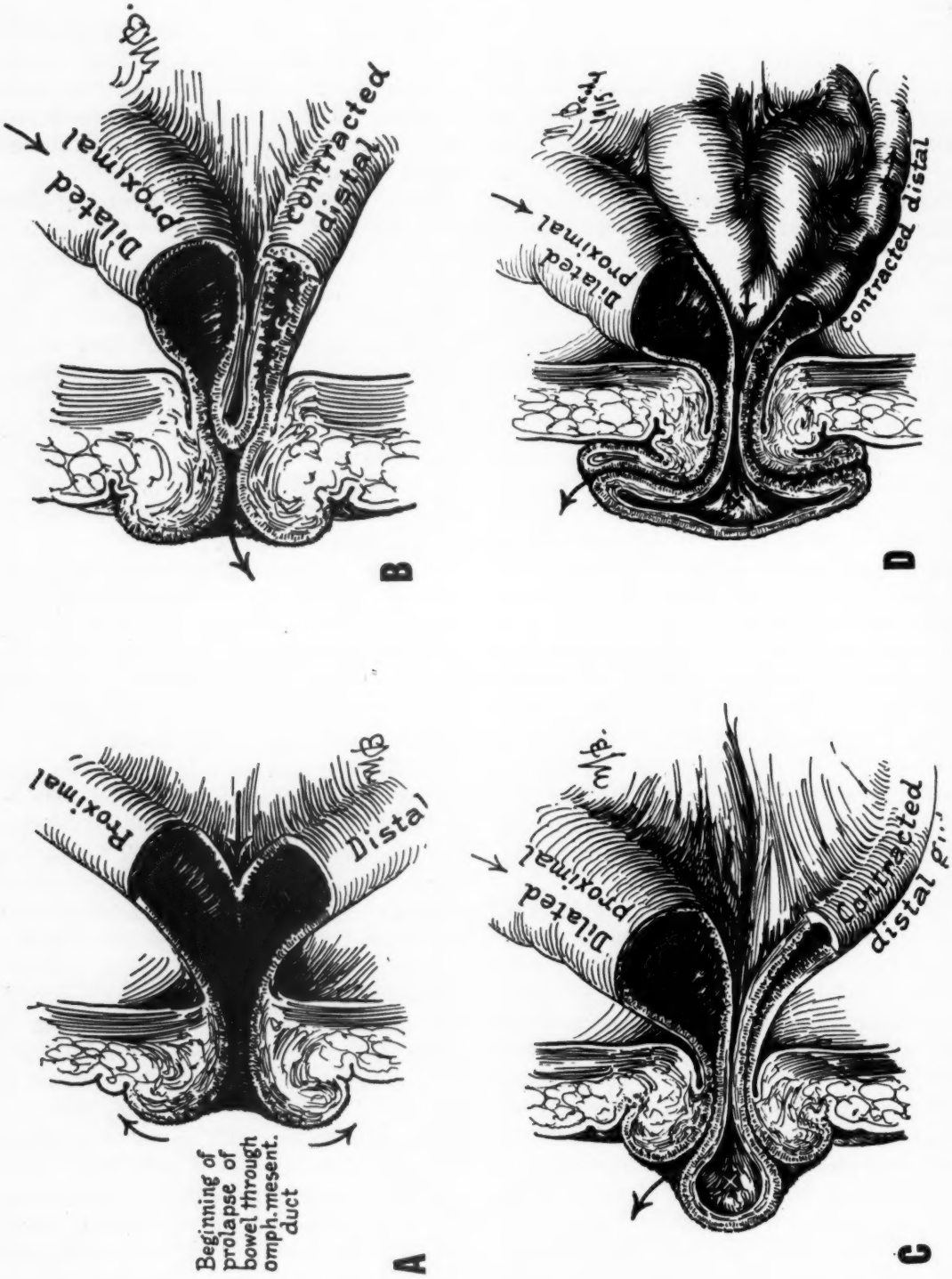
The drainage shows an alkaline reaction except when a large amount of acid producing heterotrophic gastric mucosa is present. The escaping contents will produce excoriation of the periumbilical skin unless care is taken to prevent this.

The patent omphalomesenteric duct may be easily confused with a patent urachus, whether the latter is associated with or without urinary discharge. Thus, the original clinical diagnosis made by the investigating surgeon in the cases of our patent urachus was that of omphalomesenteric duct.

Trimingham has advocated the oral administration of methylene blue to aid in the establishment of the diagnosis of a patent omphalomesenteric duct. The use of contrast media is more direct.

The introduction of an exploring probe into the opening in the red umbilical mass should not be attempted since this will not establish the diagnosis. Since the canal may be a short one or tortuous, the use of such a probe may lead to serious complications such as perforation of the bowel.

Similar dangers may be encountered if one attempts to use plastic catheters or probes. The introduction of radiopaque material utilizing a blunt-nosed nozzle has proved to be the most adequate method of determining what type of fistulous tract is present. The nozzle is inserted into the aperture of the umbilical nodule and the course of the communication is visualized. The injection of the contrast medium is carried out under roentgenoscopic control. Various contrast media may be utilized. It is our belief that water soluble contrast media such as diodrast alone, or diodrast in acacia should be first employed. Once the course and character of the communication have been established, barium-water mixtures may be utilized to outline and visualize the small bowel pattern. An attempt to estimate the caliber of the lumen of the fistulous tract should be done. If this is wide, the possibility of prolapse is much


Beginning of prolapse of bowel through omph. mesent. duct
Proximal
Distal
A
Dilated proximal
Contracted distal
B
Dilated proximal
Contracted distal
C
Dilated proximal
Contracted distal
D

greater than if a thin narrowed lumen is present.

Various other roentgenographic procedures have been utilized to evaluate the remaining portion of the alimentary tract. In none of the cases of omphalomesenteric duct has it been possible to outline the communication by means of a small bowel study following the oral administration of barium. Despite the fact that the connection between the vitelline duct is often situated in the distal ileum, barium refluxed through the ileocecal valve following a barium enema has not entered the fistulous tract. The communication, when outlined, varies in its length and size of its lumen. The connection may be very short and in some cases the bowel is situated directly in back of the umbilicus. In other cases, the omphalomesenteric duct may be elongated. Canals ranging in length up to $2\frac{1}{2}$ inches have been reported. The lumen, when outlined in our cases, was smooth and showed no distinctive pattern. In the various cases reviewed by Cullen[10] there are statements that probes were passed for a distance ranging up to 9 cm. It would appear that this was no index to the size and length of the canal since the probe may have been introduced into the lumen of the small bowel.

Some ideas concerning the formation of the patent omphalomesenteric duct at its enteric connection may be obtained from the description of Meckel's diverticulum. Usually cylindrical, this projection is smaller in diameter than the portion of the intestine from which it originates. Many variations have been recorded. Thus when the omphalomesenteric duct is long and slender it predisposes to intestinal obstruction, while a ductal opening which is large is more predestined for intussusception and prolapse. The size of the enteric opening of the channel is usually that of the intestine or smaller.

The contrast medium when introduced will, as a rule, often show the adjacent bowel loops. Traces of the contrast medium remaining in the omphalomesenteric duct may show its length and caliber.

FIG. 6. (*A*) Patent Omphalomesenteric Duct of Large Diameter. The lumen of this duct is directly continuous with that of the small bowel, and at the umbilicus its intestinal lining extends out a short distance upon the surface of the umbilicus. When the lumen of the omphalomesenteric duct is wide, there is always great danger of the bowel prolapsing and turning inside out through the duct, following the direction indicated by the arrows.

(*B*) Partial Prolapsus of the Small Bowel Through the Omphalomesenteric Duct. The wedge of small bowel has extended partly through the abdominal wall. The loop is now divided into two definite portions, the dilated and proximal, and the contracted and distal portion. The proximal portion is naturally dilated, because there is already a barrier to the adequate ecsape of the fecal contents. The distal portion is, of course, contracted, because nothing is passing into it.

(*C*) Prolapsus of the Small Bowel Through the Patent Omphalomesenteric Duct. The small bowel has prolapsed still farther through the omphalomesenteric duct. The proximal loop has become more distended, and the distal loop has become contracted still more. The lumina of both loops can be traced out to the surface of the abdomen. The mucosa of the bowel has now extended out so far that it forms a definite, roundish projection, elevated above the surface of the abdomen, and naturally covered over with intestinal mucosa, because it is the inner surface of the small bowel. Between the proximal and distal contracted loops of bowel the peritoneum is carried outward beyond the level of the abdomen, as indicated by x. At this stage only a small amount of fecal matter can escape from the umbilicus, and signs of obstruction will soon develop.

(*D*) Complete Prolapsus of the Bowel Through the Patent Omphalomesenteric Duct. The proximal loop of bowel is now markedly distended, and the distal loop is correspondingly small. Lying on the surface of the abdomen is a sausage-shaped mass. This is naturally reddish or dark red in color, because it is covered over with the mucosa of the small bowel. It has an upper opening corresponding to the lumen of the proximal loop of small bowel, and a lower opening—the lumen of the distal loop of bowel. A loop of small bowel is trying to pass outward in the chink between the proximal and distal loops, as indicated by the arrow.

(Figure 6, *A*, *B*, *C* and *D* are reproduced through the kind permission of W. B. Saunders Company from "Embryology, Anatomy and Disease of the Umbilicus" by T. S. Cullen. W. B. Saunders Co., Philadelphia, 1916.)

Prolapse of the intestine through the umbilical fistula is the most serious complication associated with a patent omphalomesenteric duct.

Kittle, Jenkins and Dragstedt pointed out in their review that this event occurred in 20 of the reported cases. This represents an incidence of 20 per cent.

First reported by Peake[38] in 1811, prolapse of the intestine through the patent omphalomesenteric duct is associated with an extremely high mortality. Three operative recoveries have been recorded in a series of 29 cases resulting in a staggering mortality rate of 89.6 per cent.[3]

Successful operative recoveries have been reported by Kittle, Jenkins and Dragstedt[27] and Bronaugh[6] in 1947 and by Arnheim[3] in 1950.

The onset of the prolapse was usually preceded by a bout of straining, crying or coughing. Such protrusion may occur at any time from some hours after birth to two years of age. The prolapse itself is due to the extrusion of a single "T" shaped bowel loop through the umbilical opening (Fig. 6).

Thus with prolapse of a single loop, the umbilical protrusion assumes an "S" shape. With prolapse of both afferent and efferent loops the mass may be "T" shaped.

The dark red surface of the loop is due to the everted intestinal mucous membrane. (Varying degrees of shock accompany the prolapse.) An attempt to reduce the prolapse manually should be made, if the infant is seen soon after the onset. When the prolapsed intestine is edematous and necrotic, manual reduction becomes impossible.

The predisposing factors necessary to produce prolapse are increased abdominal pressure such as can be produced by straining; crying; or paroxysms of coughing and a ductal lumen of sufficient caliber to permit entry and prolapse of the ileal loops. Prolapse may show an acute onset. The actual appearance of the prolapsed ileum is usually preceded by a period of obstipation.

While the diagnosis of complete patency of the omphalomesenteric duct is not difficult, it must be distinguished from certain umbilical lesions. Most usually an umbilical concretion formed by a small collection of inflammatory tissue at the umbilicus may confuse the observer. This finding is more commonly noted in adults and presents no central aperture. Umbilical granulations consisting of a small red soft tumor mass may occasionally be seen after the cord has been sloughed away. This mass arises from that section of the umbilical cord which is situated proximal to the ligature which has not come away completely. More difficult to evaluate are those cases in which there is a superficial remnant of the omphalomesenteric duct which presents the same appearance at the umbilicus as the completely patent duct.

Secretions similar to those found in the cases of patent omphalomesenteric duct may be seen in this type of anomaly. A study of the proximal segment with opaque material, however, will differentiate this condition. It is especially important to be certain that an intestinal fistula resulting from ligation of the bowel loop which has prolapsed into the umbilical cord is not present.

When the ligature on the cord has sloughed away in such a case, intestinal obstruction or intestinal fistula may be produced. As various observers have pointed out, a complete fecal fistula of the umbilicus is more likely due to this type of faulty ligation involving a prolapsed intestinal loop rather than to the presence of a patent omphalomesenteric duct. Thus, an umbilical sinus will be formed when the peripheral portion of the omphalomesenteric duct fails to close. While the findings in such cases simulate those present in a completely patent duct, intestinal drainage is never found. Patency of the peripheral segment of the omphalomesenteric duct may be erroneously diagnosed as a simple umbilical concretion or granulation.

If the sinus is only a few millimeters deep, localized cauterization may obliterate the tract and produce a cure. The tract

usually extends from the external nodule in the region of the umbilical opening into the abdominal cavity where it ends blindly. A fibrous band may extend from the enteric end of the tract to attach to the surface of the small bowel. One should be mindful of such a band in cases of umbilical sinus associated with a history of intestinal obstruction.

When the intermediate segment of the omphalomesenteric duct fails to become obliterated, a vitelline cyst may result. Trimingham[43] has noted that 2 cases of vitelline cyst have been encountered at the Mayo Clinic.

We have encountered 1 case, in which a preoperative roentgen diagnosis of mesenteric cyst was made. At operation and following subsequent histopathologic studies it was suggested that this mass was a vitelline cyst.

The position of the cyst varies greatly; thus the cyst may be attached to the ileum or the umbilicus, and at operation a fibrous strand may be demonstrated to be attached to one or both of these areas.

It may be situated in the abdominal cavity or the higher abdominal wall. When small cysts are present, they may cause no symptoms. The cysts which are situated along the posterior aspect of the abdominal wall may be detected visibly or by palpation. When the mass is increased in size, the symptoms produced will largely depend upon the size and location. Usually, the wall of such a cyst is lined with an intestinal type of mucosa. A clear mucoid fluid derived from the mucosa is usually found when the cyst is opened. Should such secretions accumulate increasing the size of the cyst, the mucosa becomes flattened and eventually unrecognizable.

No persistent abnormal vascular channels were found in the group of cases described. Moreover, a review of the hospital files has failed to reveal such cases. More recently Fraser and McCartney[17] have recorded a case of a persistent vitelline artery which produced intra-abdominal hemorrhage from a rupture of such a vessel. Manning and McLaughlin[30] and others have described cases of intestinal obstruction resulting from a persistent omphalomesenteric artery and have reviewed the persistence of this artery as a surgical problem.

With the definite establishment and diagnosis, the treatment of the completely patent omphalomesenteric duct is surgical.[28] This surgical treatment should be carried out at the earliest feasible time because of the relatively high incidence of prolapse of the intestine occurring through the umbilical fistula. As can be deduced from the data previously noted, the occurrence of this complication is associated with far more risk.

The length of time which the prolapse exists before treatment largely determines the mortality. If the infant is seen soon following the prolapse of the intestine, it may be possible to manually reduce the prolapse through the umbilical fistula. When reduction of the prolapse can be completed, the operation should be performed as soon as possible. Should the prolapsed bowel become edematous and manual reduction is impossible, it is necessary to complete a resection of the umbilicus, the omphalomesenteric duct and the involved portions of the bowel. An anastomosis of the efferent and afferent loops is then done to establish continuity of the bowel.

REPORT OF CASES

The following cases represent complete patent omphalomesenteric ducts found in infants.

Case 1. A.C. A full term male infant was delivered at The Grace Unit of the Grace-New Haven Community Hospital on January 21, 1948. The child was delivered by low forceps and weighed 3,320 grams. A stalk-like projection measuring 5 cm. in length was noted arising in the umbilical area. The stalk measured 2.2 cm. in width at the base near the skin and 3 cm. at its distal extremity (Fig. 7). The stalk demonstrated a cylindrical area 2 cm. in length. In the center of the bright red area which simulated the bowel mucosa a poorly defined central depression was present. There was moderate

FIG. 7. Case 1. A.C., male, newborn infant. The protuberant umbilical mass is demonstrated above. When the child cried or strained the mass increased in size and was more prominent. The cutaneous umbilical area was prominent and formed a collar about the central reddish mucosal mass.

eversion of the mucocutaneous junction but no gross discharge was noted at this time. The mass was especially prominent when the child strained or cried. The abdomen was moderately distended and tympanitis was present.

The first roentgen studies were undertaken on January 22; no attempt to explore the opening with a metal probe was made. A barium enema was completed to establish the patency of this portion of the bowel and to exclude other associated anomalies (Fig. 8*A*). The injection of the tract was made by first introducing a blunt-nosed, soft-nozzled catheter into the umbilical depression (Fig. 8*B*). Under roentgenoscopic control, skiodan and acacia* were introduced. Evaluation of the small intestine by use of contrast medium in order to evaluate the bowel pattern in this area was done by introducing approximately 30 cc. of a barium-water mixture through the opening into the small intestine. The connection between the small intestine and the umbilicus was outlined by these techniques (Fig. 8, *B* and *C*). Film studies were made immediately following the introduction of the contrast medium. Subsequent studies were then made of the infant to evaluate passage of the barium into the small intestine with the demonstration of the communication of the umbilicus and the small intestine. The diagnosis of completely patent omphalomesenteric duct was then established. On January 23, the umbilical protrusion showed a definite central depression and on the following day, a thin yellowish-brown ooze was discharged through the opening.

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Postponement of the operative procedure was agreed upon because of the infant's size. Despite the birth weight the initial weight loss had been excessive because of the anorexia and vomiting. The hazard of possible prolapse was recognized, but it was believed that some advantage would be gained surgically with a stronger infant.

On January 25, a small prolapse of the omphalomesenteric duct was noted. The prolapse was reduced manually. The patient was seen in the early morning on January 29 (5 A.M.). The child was restless, crying violently. The nurse stated that one hour previously during the changing of diaper she had noted that the umbilical mass had increased in size, and had become dusky purple-red instead of the usual pink color. The bowel was markedly edematous and there was a constant ooze of blood from the discolored mucosa. The abdomen was markedly distended. The child had vomited its feeding. Temperature was 104.2° F. A dull red mushroom-shaped umbilical mass measuring 9 cm. was present. One limb of the prolapse arising from the inferior margin of the mass measured 8 cm. in length. An infusion of isotonic chloride was started, the stomach aspirated and immediate surgery proposed.

An elliptical incision was made around the entire umbilical stricture. This was continued down to the fascia and to the peritoneum. A dense tissue ring surrounded the umbilicus. This was transected and the bowel loops encased in the region beyond the ring were withdrawn.

The peritoneum was opened and a loop of ileum was followed down to the fistulous tract which extended into and beyond the umbilical opening. The proximal loop of ileum was markedly dilated up to the point where it entered into the umbilical opening and the distal loop leading from the umbilical area was collapsed. A diagnosis of intussusception of the ileum through the patent omphalomesenteric duct was confirmed. A total of 64 cm. of small intestine was prolapsed. The afferent and efferent loops of ileum at the point of the intussuception appeared visable. Numerous areas of venous thrombosis in the mesentery were soon. These were transected, the stumps invaginated and a side-to-side anastomosis performed between the segments of ileum. The prolapsed intestine and the umbilicus were removed. The peritoneum, fascia and skin were closed with silk sutures.

Except for a slight febrile reaction noted for the first two days, convalescence was relatively

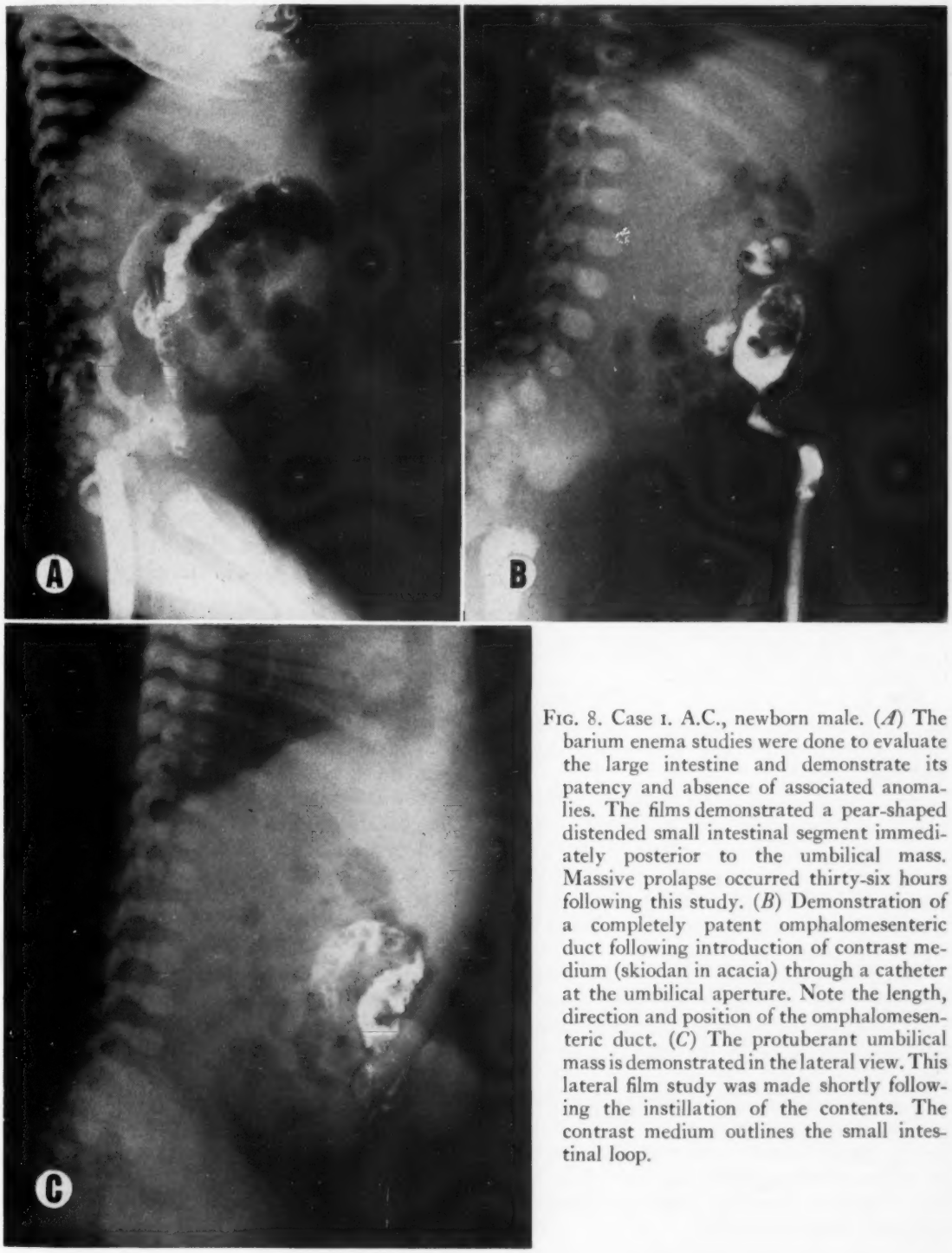

Fig. 8. Case 1. A.C., newborn male. (*A*) The barium enema studies were done to evaluate the large intestine and demonstrate its patency and absence of associated anomalies. The films demonstrated a pear-shaped distended small intestinal segment immediately posterior to the umbilical mass. Massive prolapse occurred thirty-six hours following this study. (*B*) Demonstration of a completely patent omphalomesenteric duct following introduction of contrast medium (skiodan in acacia) through a catheter at the umbilical aperture. Note the length, direction and position of the omphalomesenteric duct. (*C*) The protuberant umbilical mass is demonstrated in the lateral view. This lateral film study was made shortly following the instillation of the contents. The contrast medium outlines the small intestinal loop.

FIG. 9. Case I. A.C. Photomicrograph of specimen removed at operation. The central lumen of the omphalomesenteric duct is seen in the center of the photomicrograph. The mucosa is formed in papillary-like folds. Surrounding the lumen and the mucosal layer is a circular area of nonstriated muscle. Higher power microscopic studies showed the mucosa to be a mixture of gastric and colon glands. Heterotopic mucosa was present. The gross specimen contained the umbilical skin and the contiguous portion of duct and resected intestine.

uneventful. He had a normal bowel movement on the second postoperative day. Penicillin, whole blood, glucose and parenterally administered fluids were given.

On the third postoperative day, some moderate distention of the abdomen was noted. Clinically, it was thought that the infant was not doing well and additional consultants were requested to review the infant.

Five days following the operative procedure during a rectal examination, a massive sudden hemorrhage from the nose and mouth occurred and the infant died.

At autopsy, the lungs were markedly hemorrhagic and atelectatic. The left lower lung field demonstrated a massive infarct. Although the anastomosis itself was demonstrated to be intact, the bowel loops proximal to the anastomosis were distended and those distal to the anastomotic channel were collapsed.

Death was apparently due to intestinal obstruction and associated peritonitis following the operative procedure for the intussusception of the ileum through the omphalomesenteric duct.

The microscopic sections of the original specimens taken from portions of the prolapsed bowel demonstrated extensive hemorrhage into the mucosa and beginning necrosis of the bowel wall. Figure 9 represents a section of the patent omphalomesenteric duct.

Ether was the anesthetic agent. Despite adequate apparently skillful surgical treatment, the hazard of shock due to the tremendous defect in the volume of circulating fluid could not be adequately overcome.

This was probably based on two factors: (1) the loss of fluid because of vomiting and blood loss, (2) loss of plasma-like fluid from the prolapsed partially strangulated loops of bowel.

CASE II. M.S. This patient was two years of age when she was first seen in the Department of Radiology. The patient was delivered in another hospital in New Haven and weighed 3,430 grams. A bulbous protuberant umbilical cord was noted at birth. Following her discharge from the hospital a moderate amount of discharge was noted from the umbilicus. Despite the persistence of the discharge, because of the redness and the excoriation noted surrounding the umbilicus, this was thought to represent some infection of the navel. It was treated locally with alcohol and, occasionally, sulfathiazol ointment. The pain and redness would on occasions subside. There have been occasional episodes of nausea and vomiting with some distention of the entire abdomen. At no time has the patient complained of constipation or diarrhea. Three or four days prior to her examination, the redness and swelling had increased markedly. Despite the marked inflammatory reaction in this region, and the persistence of the discharge, there was no history of bleeding. There was a protuberant oval mass noted in the region of the umbilicus which measured approximately 3 cm. in width and was approximately 1.5 cm. in height.

Within the center of this mass, a small lumen could be seen. The mass itself was red and in-

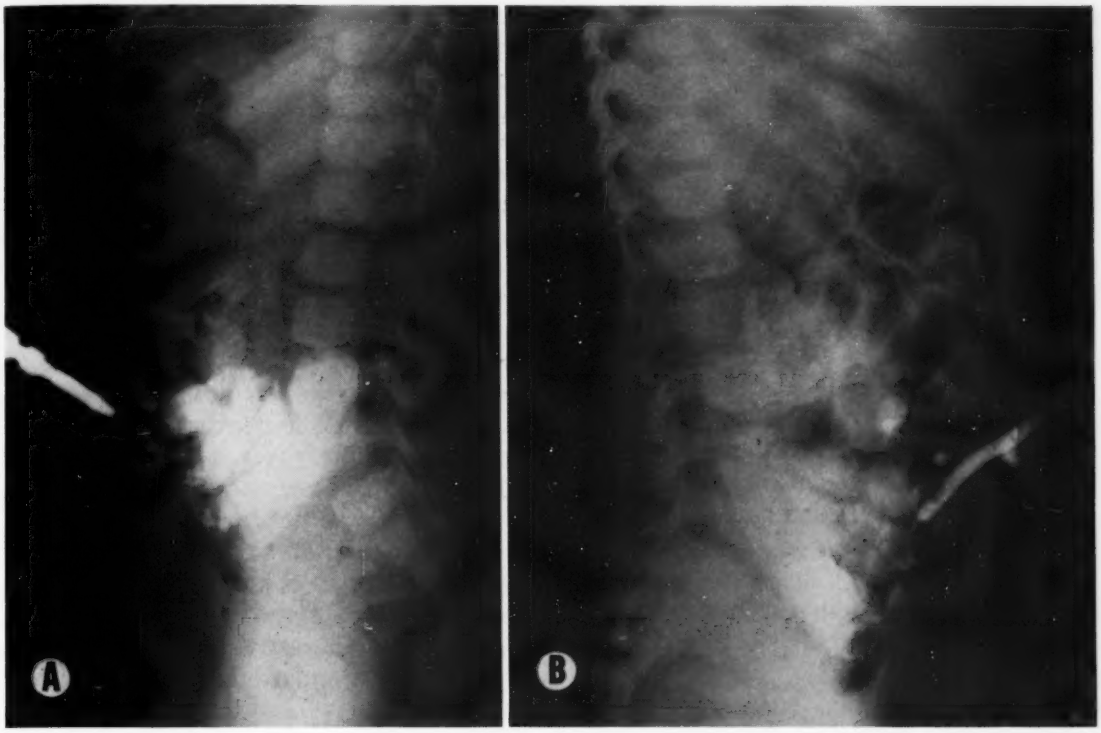

Fig. 10. Case 11. M.S., female, aged two. (*A*) Contrast medium was introduced into the umbilical opening under roentgenoscopic control. A blunt-nosed metallic adapter nozzle was introduced in the central opening of the umbilical mass. This film was made while the contrast medium, diodrast, was being introduced. Here the course of the omphalomesenteric duct is directed downward in contrast to that shown in Case 1. (*B*) A soft rubber catheter was introduced into the umbilical aperture and visualization of the adjacent small intestinal loops and the proximal large intestine was completed. Despite the intermittent episodes of partial prolapse this defect was successfully repaired.

durated. Despite the induration and thickening, there was ridging of the margins of the bowel. No attempt to probe the lumen was made. When the infant cried, there was a very marked protrusion of the mass. The mass would become turgid with straining and crying. After such episodes the mass greatly increased in size, and it was noted that the remainder of the abdomen became distended. A culture was made from the discharge arising from the umbilicus and it demonstrated *B. coli* and streptococci. However, no hemolytic streptococci could be demonstrated in this group. Because no fecal contents were extruded from the opening, the referring physician and family refused to accept the diagnosis of a patent omphalomesenteric duct. For this reason roentgenographic studies were undertaken.

On October 25, 1948, a small amount of skiodan and acacia was introduced into the lumen of this umbilical mass and subsequent roentgenographic studies were completed. The communication extending from the umbilicus into the small intestine, *i.e.* the distal ileum proximal to the cecum would be demonstrated (Fig. 10, *A* and *B*). The diagnosis of a secondary infection in a patent omphalomesenteric duct was established and an operative procedure was advised.

No other congenital defects were present. Two months following the roentgen studies, the operative procedure was completed. A narrow bowel-like structure was seen to extend from the umbilicus to the ileum. This short narrow canal was approximately 4 cm. in length and approximately 1 cm. in width. The diverticular-like extension was transected from its junction with the ileum. The defect in the ileum was closed and the continuity of the bowel was maintained. No abnormal cord-like structures lying in relationship to the omphalomesenteric duct were noted.

The patient experienced an uneventful convalescence and was discharged in good condition

without evidence of herniation or umbilical discharge.

COMMENTS

While a marked preponderance of omphalomesenteric duct remnants occurs in males, one of our cases was found in a female infant. No other related or unrelated developmental anomalies were found in these patients. In each of the cases, the simple roentgenographic procedures definitely established the diagnosis. In the first case, the subsequent massive prolapse was recognized shortly after its occurrence and although surgical intervention was undertaken immediately, the death of this patient occurred following the operation.

In the second case, episodes of prolapse of the patent omphalomesenteric duct of varying degrees apparently occurred. These episodes were characterized by bouts of cramp-like abdominal pain, nausea and vomiting and abdominal distention. Surgical intervention was successful in this case. With the establishment of a definite diagnosis, the treatment of the completely patent omphalomesenteric duct is surgical. This surgical treatment should be carried out at the earliest feasible time because of the relatively high incidence of prolapse of the intestine occurring through the umbilical fistula. As deduced from the data previously noted, the occurrence of this complication is associated with far more risk.

URACHAL ANOMALIES

From the previous embryological review, it will be remembered that urachal anomalies are associated with and arise in the course of the development of the bladder. The various types of anomalies exist depending upon which portions of the urachus have persisted or have become obliterated.[41] The types of urachal anomalies have been enumerated in the classification by Trimingham.

Since the patent urachus may be easily confused with a patent omphalomesenteric duct, 2 cases of completely patent urachus are presented for comparison. Satisfactory and definite differentiation of these abnormalities was made roentgenographically utilizing simple contrast injection techniques. The first case has been previously reported and the methods utilized to demonstrate the urachal canal were enumerated in a previous paper in the AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY.[30] Trimingham, in 1948, reviewing the material available at the Mayo Clinic, demonstrated 2 cases of completely patent urachus. An additional case of completely patent urachus was described by Fox in 1951.

In addition, other cases have been noted in the urological journals. A completely patent urachus is a rare abnormality appearing as a fistulous communication between the bladder and the umbilicus. The amount of urine escaping from the urachal lumen will depend upon the size of the urachal canal.

The urachal opening may vary from the size of a pin point and thus permit little urine to escape from the umbilicus or it may be larger and permit easy escape of a stream from this site.

The umbilicus may show little alteration from the normal appearance and the urachal opening may be scarcely visible. Occasionally, radial folds surrounding the umbilicus can be found, at the center of which there is a definite funnel-like depression (Fig. 11).

In other cases the urachus may be represented by a large protuberant umbilical mass which will present a mucosal covering indistinguishable from that of the small intestine. In other cases, bright red umbilical projections ranging up to 4 cm. in length may be found.

Occasionally the umbilical mass may resemble a penile protrusion (Fig. 12).

Blockage caused by infection may produce an intermittent flow of urine because of the involvement of the urachal canal. The mild irritation of the skin surrounding the umbilicus, associated with the escaping urine, differs from the marked excoriation

with a completely patent omphalomesenteric duct. In the latter, digestion of the skin due to the irritating effect of the abdominal contents may also occur. If no infection is superimposed on a patent urachus, there is rarely any associated pain or discomfort. Some investigators have noted that the urachal opening can occasionally be visualized at the bladder dome during cystoscopic examination.

The acquired type of umbilical urinary fistulas are seen more frequently than those of the congenital variety. The acquired fistulous tracts are usually associated with obstructing lesions of the lower urinary tract. Urinary obstruction produced by urethral stricture, hypertrophied prostate gland or tumor of the bladder base forces urine through the incompletely obliterated urachal canal producing an acquired umbilical urinary fistula. Thus it is to be stressed that in the acquired urinary fistulae, no abnormality of the umbilicus is noted at birth. Later in life dribbling of urine from the umbilicus may occur.

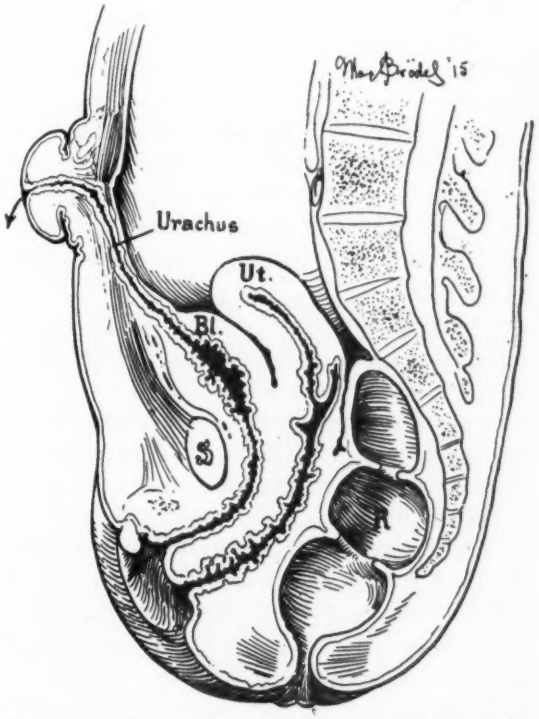

Fig. 11. A Patent Urachus With a Mushroom-like Projection at the Umbilicus. (Schematic.) (Reproduced through the kind permission of W. B. Saunders Company from "Embryology, Anatomy and Disease of the Umbilicus" by T. S. Cullen. W. B. Saunders Co., Philadelphia, 1916.)

A partially patent urachus will be found in those cases in which persistence of the peripheral portion of the urachus has remained patent, presenting an umbilical urachal sinus opening. Secretory cells may be retained in the primitive urachal epithelium in the sinus and a clear mucinous secretion is noted in the sinus opening. After the cord has come away, the persistence of umbilical drainage focuses attention on this type of anomaly. The sinus may extend down to the bladder dome for a variable distance. A urachal cyst which ruptures through the abdominal surface in the umbilical area may also produce a persistent umbilical urachal sinus.

A common congenital anomaly is that of urachal cyst which results when the intermediate portion of the urachus persists and shows various degrees of dilatation. Investigators have maintained that the urachal canal in its normal stage is usually incompletely obliterated and that numerous cyst-like cavities persist in these areas throughout life.[40] Thus, urachal cysts may vary in size and may or may not be infected. Small cysts may be found incidentally and as a rule produce no clinical symptoms. In other reported cases urachal cysts have retained large proportions.

Intermittent communications with the bladder and the cyst may exist.[47] The emptying and filling of the cysts through such an opening will produce a variation in the size of the cavity.

Trimingham and McDonald, in reviewing the histopathology of their group of urachal cysts, noted that these often demonstrated a lining of epithelium of the transitional type. In no cases were they able to demonstrate an intestinal type of mucous membrane which occasionally may be found in the urachal remnants in the umbilical area. At times the lining epithelium of the cyst may be so altered that the original histologic strictures can hardly be recognized.

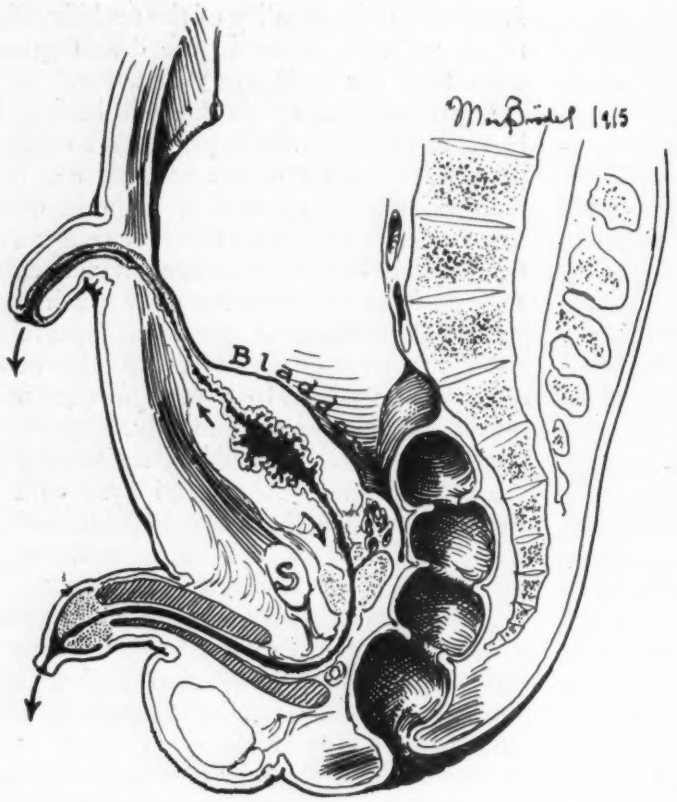

FIG. 12. A Patent Urachus with a Penile Projection at the Umbilicus. (Schematic.) Where the urachus remains patent the umbilical end may appear as a small depression in the floor of the umbilicus. In some instances a mushroom-like elevation occupies the site of the umbilicus. In exceptional cases a definite penile projection springs from the umbilicus, and at the end of this is the opening of the urachus, as indicated in the picture. (Reproduced through the kind permission of W. B. Saunders Company from "Embryology, Anatomy and Disease of the Umbilicus" by T. S. Cullen. W. B. Saunders Co., Philadelphia, 1916.)

The wall thickness varies and in some cases the dimensions of the cyst wall have attained a thickness of 1 cm. The fluid contained in the cyst may resemble the tenacious and rope-like contents found in a dermoid cyst. The finding of chocolate colored contents is suggestive of previous old hemorrhage in the cyst. A patent urachal cyst when presented to the examining physician is usually in the infected stage. Depending upon the extent and type of infection, there will be varying degrees of pain, tenderness and induration of the lower part of the abdomen.

These physical findings are often associated with fever, malaise and severe prostration. In many cases, there may be associated and varying gastrointestinal and urinary symptoms. The overlying skin may be inflamed and actual rupture of the abscess in the umbilicus may result.

It is necessary to distinguish the urachal cysts and various lesions which may produce cystic masses in the lower abdomen. Thus various diagnostic measures may be necessary to evaluate and exclude a distended bladder, ascites, ovarian cysts or a localized peritonitis. Occasionally, it may be necessary to complete an exploratory laparotomy in order to provide an adequate differential diagnosis.

In all cases catheterization of the bladder, intravenous urography and retrograde pyelography to evaluate the urinary tracts should be done. A detailed survey of the history of the patient in such cases is a tremendous aid.

The various roentgenographic procedures utilized in the examination and the differential diagnosis of patent urachus have been previously discussed and are similar to the injection techniques which are utilized for the evaluation of patent omphalomesenteric duct anomalies.

It has been found that completion of the lateral film studies while the contrast material is being introduced into the urachal canal has provided the most satisfactory

visualization of this anomaly.

In every case of patent urachus, it is wise to investigate the patency of the lower urethra. This may be done by visualization of the upper urinary tract by the use of contrast medium given intravenously, or by means of subcutaneous urography, or by means of opaque medium introduced into the subcutaneous tissues.[42,45]

In older infants where retrograde pyelography and cystoscopy can be utilized, direct examination of the bladder should be attempted.

Case III. M.G. This case[30] and the accompanying illustrations represented the first roentgen demonstration of a patent urachal stalk recorded in the "Consolidated Indices" of the American Journal of Roentgenology and Radium Therapy. A female infant weighing 6 pounds and 10 ounces delivered on November 5, 1942, showed a well defined defect of the umbilicus with a protruding elongated mass covered with overhanging skin, the center of which contained mucosa resembling that of small intestine. This cylindrical mass extended out approximately 6.5 cm. from the anterior abdominal wall and was approximately 3.2 cm. in diameter. The entire mass resembled a penile protrusion (Fig. 13).

On November 18, 1942, diodrast injected by means of a catheter through the opening of the abdominal mass visualized the bladder and the urachal stalk (Fig. 14, *A* and *B*).

On November 27, the examination of the gastrointestinal tract excluded defects of this system. On December 7, subcutaneous urography was completed demonstrating normal pelves and calyces in the upper urinary tract (Fig. 15, *A* and *B*). The ureters appeared normal.

On January 6, at operation, the narrowed urachal stalk and portion of the bladder attached to the umbilicus were excised and removed along with the umbilicus. The postoperative course of the child was uneventful, and the wound healed with discharge. The child was able to urinate normally. The patient was discharged from the hospital on January 19, 1943. The patient has been seen on numerous occasions in the out patient division and has continued to develop normally.

Case IV. E.H. The patient was a female infant weighing 6.11 pounds, a normal spontaneous delivery on October 3, 1949. No gross abnormalities could be distinguished with the exception of a large protuberant mass, cylindrical in shape, the sides of which were covered with normal skin. The central area contained a sharply defined segment of mucosa similar to that originally demonstrated in Case I.

Fig. 13. Case III. M.G., newborn female. The large cylindrical umbilical mass is demonstrated above, a wide diastasis of the rectus muscles was palpated above the defect. Although the examining resident at first considered this to be an omphalocele or a defect of the omphalomesenteric duct, contrast studies showed this to be a completely patent urachus.

While it resembled mucosal pattern, there was no ridging of the epithelium in this area. The cylindrical mass was approximately 3 cm. in length and approximately 2 cm. in width. Despite the presence of this large abdominal mass, there was no evidence of abdominal rigidity or distention. The defect in the mass was noted immediately following delivery. Despite the protuberant mass, the patient could be fed adequately.

On October 8, 1949, five days following delivery, the nurse noted that a large amount of fluid was forcibly ejected from the cord. The examination of the infant at this time demonstrated a large excoriated area surrounding the cord. A furacin ointment was applied. Thereafter it was noted that although the patient could void normally, the persistent discharge of clear yellow tinged fluid from the center of the mass sug-

FIG. 14. Case III. (*A*) Roentgen demonstration of a completely patent urachus. A soft catheter was introduced into the umbilical opening of the urachus and 10 cc. of 35 per cent diodrast was injected. (*B*) Distention of the bladder by the introduction of increased amounts of contrast medium is shown. (Reproduced by permission from Nichols and Lowman.[30] AM. J. ROENTGENOL. & RAD. THERAPY, 1944, *52*, 615–619.)

gested that a patent urachus was present. On various occasions, it was noted that anywhere from 1 to 2 ounces of urine was discharged from the umbilical opening. Throughout this period, the patient was given penicillin and intramuscular medication in order to control the infection.

On October 12, 1949, a skiodan and acacia mixture was introduced through the opening of the abdominal mass with visualization of the bladder and urachal stalk (Fig. 15, *A* and *B*).

The escape of contrast medium through the urethral opening of the bladder could also be demonstrated at this time (Fig. 15*C*).

The lateral roentgenograms demonstrated small intestinal loops to lie in relationship to the posterior margins of the umbilical opening, but no evidence of a patent omphalomesenteric duct was present. Operation was advised but was refused by the parents. The patient was readmitted into the hospital on April 27, 1950, complaining of persistent discharge of urine through the navel. It was noted that, although the umbilical voiding at birth was in the form of a well defined stream, only a few drops of urine are seen to be discharged from the umbilical opening at this time. Leakage of urine occurred only when the child voided from the urethra.

On April 29, 1950, the barium enema studies were completed and these demonstrated no abnormalities of the large intestine. The upper urinary tract demonstrated no evidence of gross hydronephrosis, with adequate visualization of the kidney calyces, pelves and ureters.

On May 4, 1950, an operation was completed. The details of the operation consisted of the following: A French No. 5 ureteral catheter was passed through the umbilical fistula into the bladder, and the bladder filled with about 65 cc. of saline. An incision about 4 inches in length was then made beginning approximately $\frac{3}{4}$ inch above the symphysis pubis and extending up to and surrounding the umbilical hernia. The anterior rectus sheath was incised in the midline,

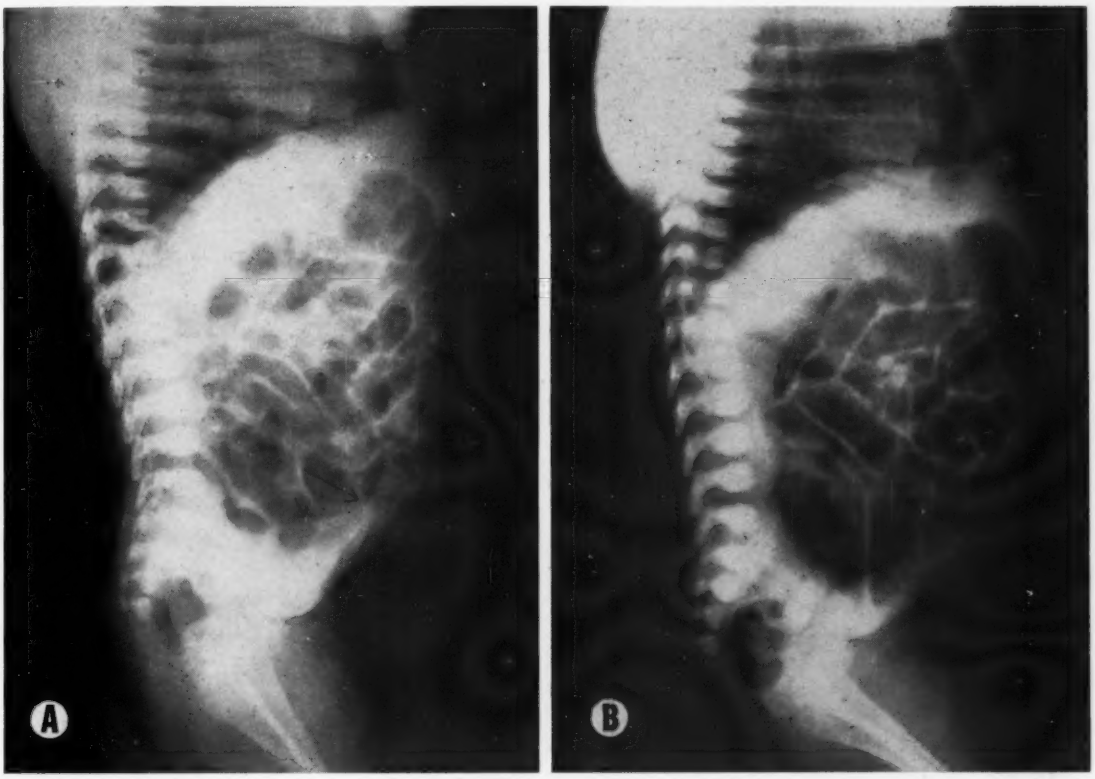

Fig. 15. Case III. (*A*) The arrows outline the superior margin of the bladder and the urachal stalk in the lateral view. The upper urinary tract was studied by subcutaneous injection of 35 per cent diodrast in normal saline. This was introduced into the posterior subscapular area. (*B*) Following urination the bladder is contracted. (Reproduced by permission from Nichols and Lowman.[30] Am. J. Roentgenol. & Rad. Therapy, 1944, *52*, 615–619.)

the recti separated, and the peritoneum reflected upward, and the bladder opened through a vertical midline incision about 1 cm. in length. The umbilicus was then excised down through the anterior rectus sheath, and the ureteral catheter was palpable within a firm tube of tissue running from the umbilicus to the vertex of the bladder. This tract was freed up from the peritoneum posteriorly and from the recti anteriorly, and the umbilicus with the intact tract was then amputated from the vertex of the bladder. This opening was closed with a continuous inverting suture of No. 00 plain catgut reinforced with a second layer of inverting interrupted sutures of the same material. This defect in the bladder was about 1.5 cm. in length. A French No. 22 two wing-catheter was then inserted through the other bladder wound, and the bladder wall was inverted around it with two interrupted sutures of No. 00 plain catgut. The prevesical space was drained with a small Penrose drain, and the wound was closed with interrupted No. 00 chromic catgut to the anterior rectus sheath and interrupted silk to the skin. The suprapubic tube was fastened to the edges of the skin with F-silk. The postoperative course was uneventful and the patient was discharged from the hospital on May 17, 1950.

SUMMARY AND CONCLUSIONS

It is thus seen that aberrations of the structures of the umbilical cord may be found in many variations depending upon the extent of the obliteration which has occurred in the omphalomesenteric duct, the urachus, and the accompanying vitelline vessels. The obliteration of the structures may occur separately and in combinations. Meckel's diverticulum, which is the commonest anomaly found, is the one in which the proximal portion of the duct fails to undergo obliteration. Unusual and rare is the complete patency of the omphalo-

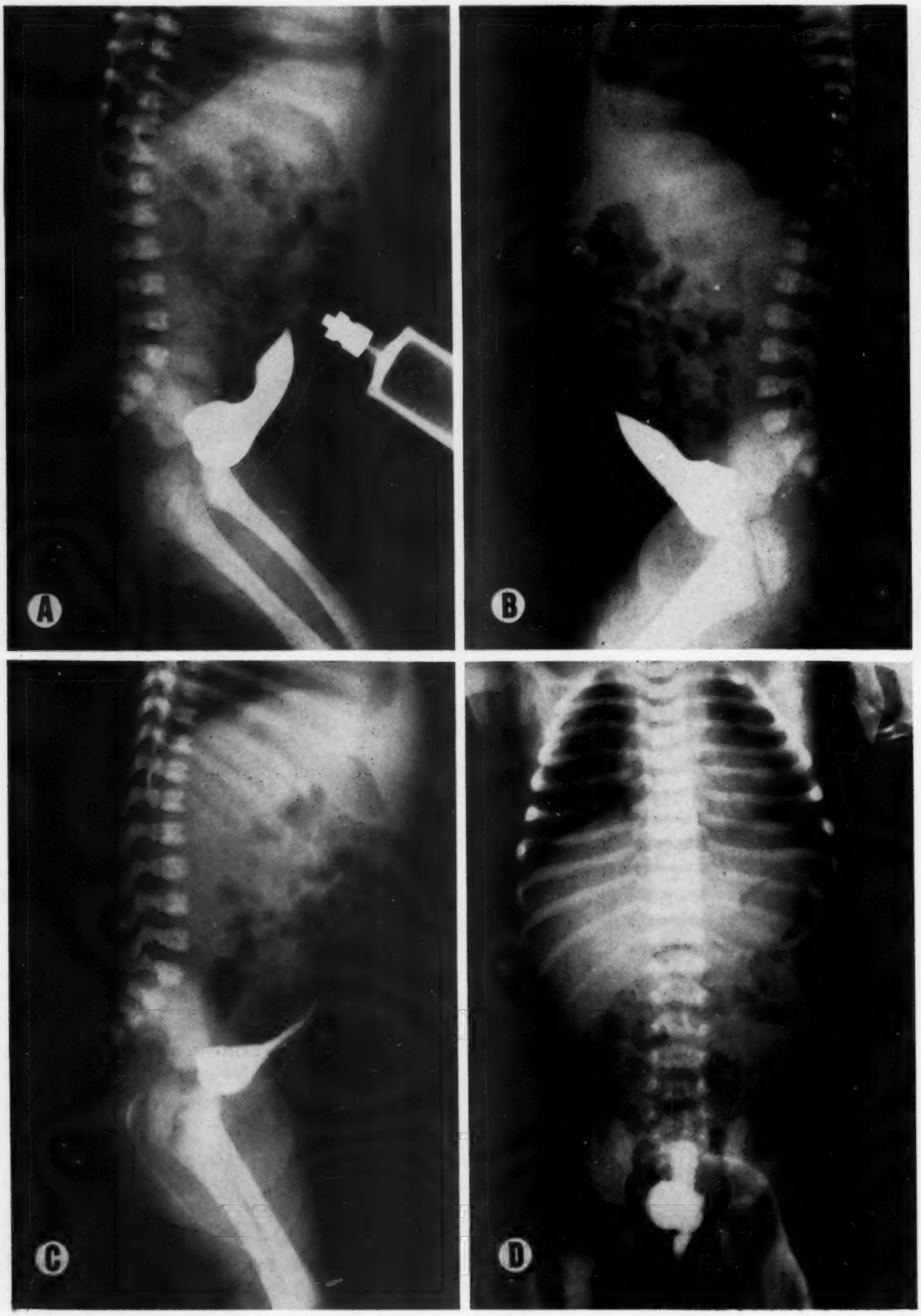

FIG. 16

Fig. 17. A male infant. The arrows outline the large sac extending beyond the confines of the abdominal wall. The gas-filled distended small intestinal loops in the sac of the omphalocele are adequately demonstrated. Note the distended portion of the stomach and the group of loops contained in the omphalocele.

mesenteric duct. Moreover, complete patency of the urachus is also rarely encountered. The diagnosis in such cases can be safely and most conclusively established by simple roentgenographic procedures by contrast visualization of the fistulous tract. The investigation of an umbilical protrusion by a metal probe is dangerous since such a procedure may not aid in establishing the diagnosis. Perforation of the urachal canal, bladder wall or intestine may also result following probing. The radiologist is thus able to provide techniques for the recognition of many of the umbilical malformations. With the early clinical recognition of these conditions, utilization of modern surgical techniques, adjuvants and antibiotics should result in a greatly lessened surgical mortality.

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Mr. Howard Reynolds of the Department of Photography of the Yale University School of Medicine completed the photographs.

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Fig. 16. Case iv. E.H., newborn female. (*A*) Demonstration of a completely patent urachus and urachal stalk. The elongated curvilinear tract extending from the umbilicus to the bladder dome is outlined. A blunt nosed nozzle was used to introduce skiodan in acacia. (*B*) and (*C*) demonstrate the bladder in various stages of contraction. In (*C*) a small rounded collection of contrast medium in a distended portion of the distal urachus may represent a cystic dilatation of the urachal stalk. (*D*) In the posterior view opaque medium outlines the bladder dome and urethra.

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DYSPHAGIA DUE TO A DIAPHRAGM-LIKE LOCALIZED NARROWING IN THE LOWER ESOPHAGUS ("LOWER ESOPHAGEAL RING")

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FOR A number of years we have been interested in a group of patients with dysphagia who do not fall in any of the commonly discussed groups of dysphagia and who seem to represent a characteristic clinical and roentgenological entity. The patient's complaint is intermittent dysphagia. The roentgenological picture is characterized by a concentric smooth diaphragm-like narrowing in the lower esophagus, approximately 5 cm. above the diaphragm.

One of us (R. S.) has presented some of these cases at several post-graduate courses but we have hesitated to publish our material, in spite of characteristic clinical and roentgenological findings, in the hope of obtaining more definite knowledge about the nature of the lesion. The recent publication of Ingelfinger and Kramer[1] concerning similar cases causes us to publish our experience, even though the etiology of the lesion still remains in doubt. Such a discussion appears particularly necessary in order to define this entity clearly and to avoid making it a catch-all for numerous nonconnected retrosternal complaints.

We have seen 5 cases which fulfill the clinical and roentgen criteria of the syndrome. A brief history of each is given in the legends under the appropriate illustrations. In addition, we have, as have others,[2] quite frequently observed patients who exhibited a similar roentgenological picture, but who did not have dysphagia.

ROENTGENOLOGICAL CHARACTERISTICS OF THE LOWER ESOPHAGEAL RING IN THE PATIENT WITH DYSPHAGIA

A thin, ring-like narrowing is seen in the lower esophagus. The ring is present constantly and does not change in position, but is only visible when the esophagus above and below is filled enough to dilate to a caliber greater than the diameter of the ring. When the esophagus is collapsed, however, the remaining coating still shows a change in the mucosal pattern starting at the level of the ring, even though the ring itself is no longer visible (Fig. 4).

The distance of the ring from the diaphragm varies somewhat from patient to patient, the greatest distance in our series being 5.5 cm., the smallest 4 cm. If the esophagus distal to the narrowing balloons out, as for instance during the Valsalva test, the ring seems to climb away from the diaphragm, and, conversely, it seems to migrate towards the diaphragm when the distal esophagus collapses. At a given degree of filling or contraction of the esophagus, however, the distance of the ring from the diaphragm appears to be constant in each case.

The smooth, concentric ring is usually 2 to 4 mm. thick and always constricts the caliber of the esophageal lumen to the same diameter in a given patient.

The widest ring we have demonstrated in a patient with dysphagia is 1.8 cm. The narrowing may be very marked, and in our most severe case reduced the caliber of the esophagus to 3 mm. There is no delay in the passage of barium, even if the narrowing is very marked.

A solid bolus of food or a large capsule can slightly stretch the ring; in one case the diameter stretched from 15 mm. to 20 mm. (Case IV). When the bolus has passed, the ring returns to its original size.

As a solid bolus is pushed through, the ring is bent downward much as a tree is bent in a strong breeze (Fig. 7). This occurs to a lesser extent with a liquid stream of

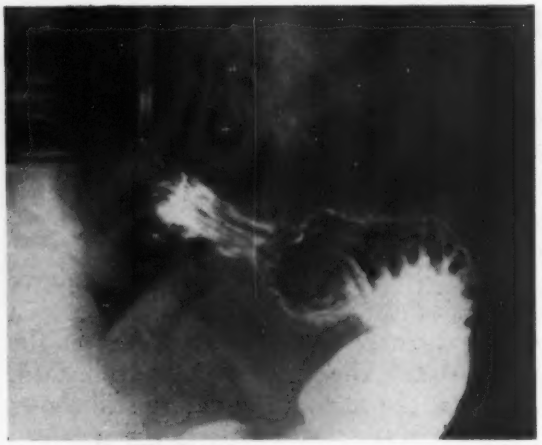


FIG. 1. Case 1. R. B., male, aged fifty-six. Dysphagia with bread and meat for eighteen months; 20 lb. weight loss. Hiatus hernia without dilatation above. No delay of barium at cardia (see Fig. 2).

barium. The downward bending of the ring produces a characteristic squaring or beaking at the edge of the lumen just below. This squaring or beaking is more pronounced in cases in which the lumen is markedly narrowed. This phenomenon is not seen below the narrowing produced by the muscle at the upper end of the phrenic ampulla and helps to differentiate the two.

The esophagus above the ring is not abnormally wide, even when the diameter of the ring is very small. In one case (Case 1), a definite herniated portion of the stomach was present, immediately below the ring (Fig. 1 and 2). In the remaining 4 cases, the lumen became wider and the mucosal folds thicker below the ring suggesting that the ring was at the herniated esophagogastric junction. This problem will be discussed in more detail later.

ROENTGENOLOGICAL CHARACTERISTICS IN THE PATIENT WITHOUT DYSPHAGIA

Quite frequently, a ring-like structure is seen in the lower esophagus in persons who have no difficulty in swallowing. It has been described as a curiosity of questionable significance by Templeton.[2] Often, it is demonstrable only when the lower esophagus balloons during deep inspiration or during the Valsalva test (Fig. 12). This ring greatly simulates that seen in the patients with dysphagia. The diameter is, however, almost without exception larger (Fig. 13). While the diameter of this ring in the cases which we examined appeared to be constant on a given day, there was sometimes a change in the diameter in those few cases which we have re-examined months or years later. The ring in some patients was wider, in others narrower, at the later examination. In contrast, the symptomatic rings appeared constant in diameter, even if re-examined several years later.

While the asymptomatic ring greatly simulates the symptomatic ring when it is small, the similarity is less striking in larger rings (Fig. 14). At present, we do not know whether the symptomatic and the asymptomatic rings are due to a similar mechanism, nor whether the asymptomatic case may become symptomatic with further contraction and stiffening of the ring.

CONCOMITANT ROENTGENOLOGICAL FINDINGS

Some gastrointestinal complaint was the reason for the roentgenological examination in most of the patients discussed in this

FIG. 2. Case 1. Localized, constant narrowing at junction of esophagus and herniated stomach demonstrated with marked filling of esophagus. Arrow indicates diaphragm.

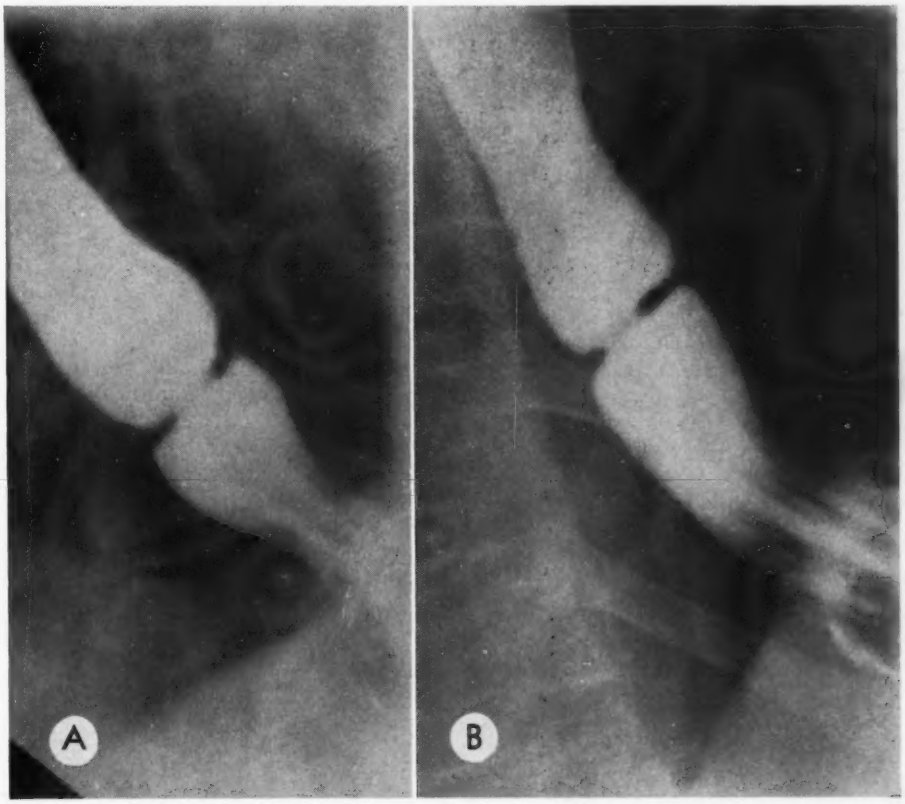


FIG. 3. Case II. T. T., male, aged thirty-five. Two and one-half year history of short episodes of dysphagia produced by meat or bread, aggravated by drinking fluid at the time of difficulty. (*A*) First observation. (*B*) Four months later. Note the completely unchanged appearance. A negative esophagoscopy had been performed two days prior to second examination (see also Fig. 4).

paper. It is therefore not surprising that 5 of the total group had duodenal ulcers. None of the patients with dysphagia had an ulcer, however, and the presence of ulcers in some of the patients without dysphagia appears purely coincidental.

CLINICAL PICTURE

Five adult male patients complained of dysphagia, and for the most part the difficulty occurred with solid foods. The diameters of the rings were 3 mm., 8 mm., 8 mm., 13 mm., and 18 mm., respectively and included all patients with a ring less than 14 mm. in diameter.

Dysphagia dated back from one to nine years and in 3 cases had become progressively more severe. Despite the duration of symptoms, only 1 patient had lost weight and he had subsisted on nothing but liquids and soft foods for one year. Another could swallow solid food only after painstaking mastication. Those who took solid food had sudden episodes of substernal pain and discomfort when a morsel of food, usually meat or bread, became lodged above the constriction. Drinking liquid would sometimes force the offending bolus through with immediate relief of symptoms. Usually, however, fluids taken at this moment would back up and increase the discomfort. One patient obtained relief by vomiting. Ingelfinger and Kramer[1] give an excellent description of the symptoms which greatly simulate those of our patients.

This episodal character of the dysphagia was striking in all but the first case. Unless an unusually large bolus of food was swallowed, the patients were without symptoms. It is not surprising that the absence

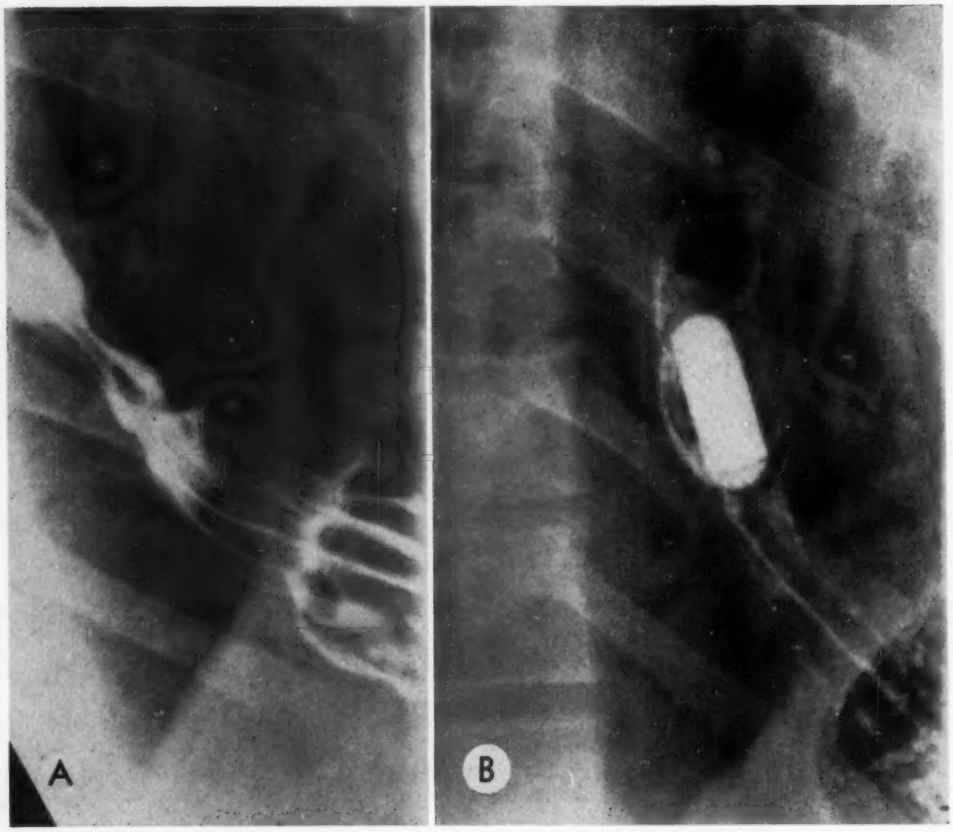


FIG. 4. Case II. (*A*) Region of ring still clearly visible in collapsed and almost empty esophagus. (*B*) Barium-filled capsule held above ring. Symptoms at this moment similar to those during attacks. Capsule stayed until it dissolved.

of weight loss and the discrepancy between periods of perfect well being and episodes of very marked dysphagia caused some of the patients to be labelled neurotics.

In the 2 patients with a ring 8 mm. in diameter (Cases II and III), the symptoms could be reproduced by lodging a barium-filled gelatin capsule 1 cm. in diameter (size 000) above the ring. The capsule was not tried in Case I, the case with the narrowest ring. In the 2 patients in whom the ring was wider than 1 cm., we followed the suggestion of Ingelfinger and Kramer and gave bread followed by barium mixture in order to demonstrate the obstruction and reproduce the symptoms. In all 5 cases, however, the ring was clearly visible without the help of capsule or food.

As stated before, the rings in the 5 patients with dysphagia were almost without exception narrower than those in the asymptomatic group (Fig. 13). As the chart shows there is only a slight overlap in the diameters of the two groups. It appears likely that in the borderline zone eating habits determine the presence or absence of dysphagia.

In 2 of our patients, dysphagia began when they were approximately thirty years old; in the other 3 it occurred when the patients had reached the early fifties.

The sex distribution is of interest. As mentioned above, all of our patients with symptoms were males as were those of Ingelfinger and Kramer. Of the 17 asymptomatic cases, which are included in this study, 12 were males and 5 were females.

ESOPHAGOSCOPIC FINDINGS

Esophagoscopy was performed in 4 of

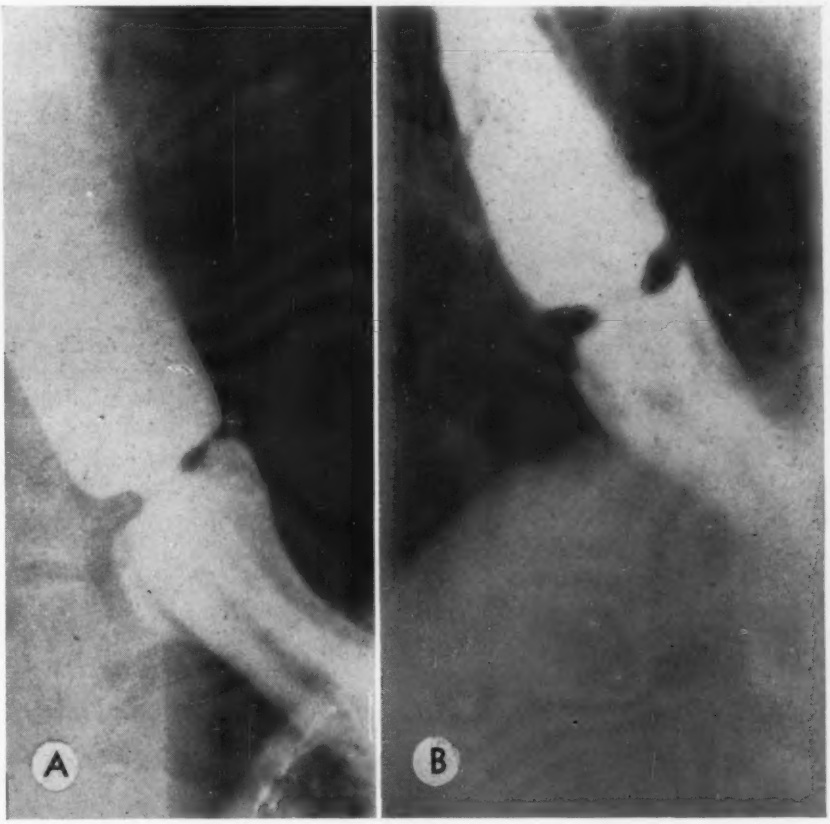


Fig. 5. Case III. K. H., male, aged thirty-eight. Nine year history of short episodes of dysphagia (meat, bread, pills). Water drunk during these episodes backs up and increases his symptoms. (*A*) First examination. (*B*) Two and one-half years later. Note that the diameter of the ring is identical (see also Fig. 6).

the cases with clinical symptoms (Dr. Edward B. Benedict or Dr. Dwight E. Harken). No stricture was seen in 3 of them. In the fourth case (Case I), a 3 mm. opening was seen in the lower end of the esophagus corresponding to the roentgenological findings. It is of interest that the endoscopist in 2 cases (Cases III and IV) saw what appeared to be gastric folds above the diaphragm, but did not notice any narrowing above these folds which might be called a cardia. In 2 of the cases (Cases II and III) the esophagoscope was passed into the stomach without difficulty.

No ulcer or scar was seen in any of the 4 patients.

GROSS ANATOMICAL AND HISTOPATHOLOGICAL FINDINGS

Case I, the patient with a ring 3 mm. in diameter, came to surgery (Dr. Dwight Harken). A herniated piece of stomach was found above the diaphragm. The esophagogastric junction appeared normal to inspection and palpation. After an opening had been made into the herniated portion of the stomach, a tiny 3 mm. hole, representing the markedly narrowed connection with the esophagus, was seen in the dome-like upper end of the stomach. The edge of the hole was smooth. An esophagoplasty was performed.

For histopathological studies, only small pieces from the edge of the ring were obtained. They showed esophageal mucosa with marked hyperkeratosis, but no evidence of ulcer, scar or inflammation. The muscularis was not included in the specimen. One of Ingelfinger and Kramer's cases was operated on and showed "no evidence

FIG. 6. Case III. Four spot roentgenograms showing the identical diameter of the ring whenever it is demonstrated. All four were made on the same day (see also Fig. 7).

of inflammation or fibrosis but merely extreme muscular thickening."

DIFFERENTIAL DIAGNOSIS

The roentgenological picture is so characteristic that most of the usual causes of dysphagia can be excluded easily. The smoothness and the thinness of the ring eliminates cancer. A web, as seen in Plummer-Vinson's syndrome, does not enter into the differential diagnosis because of the thickness of the lesion, its location, the absence of anemia, and the sex of the patient. There is no similarity to cardiospasm. The diaphragm-like short segment of narrowing is completely different from the awl-

FIG. 7. Case III. A barium-filled gelatin capsule is trying to squeeze through the ring. The lower half of the capsule has opened and is in the process of emptying the barium. Note the downward bending of the ring.

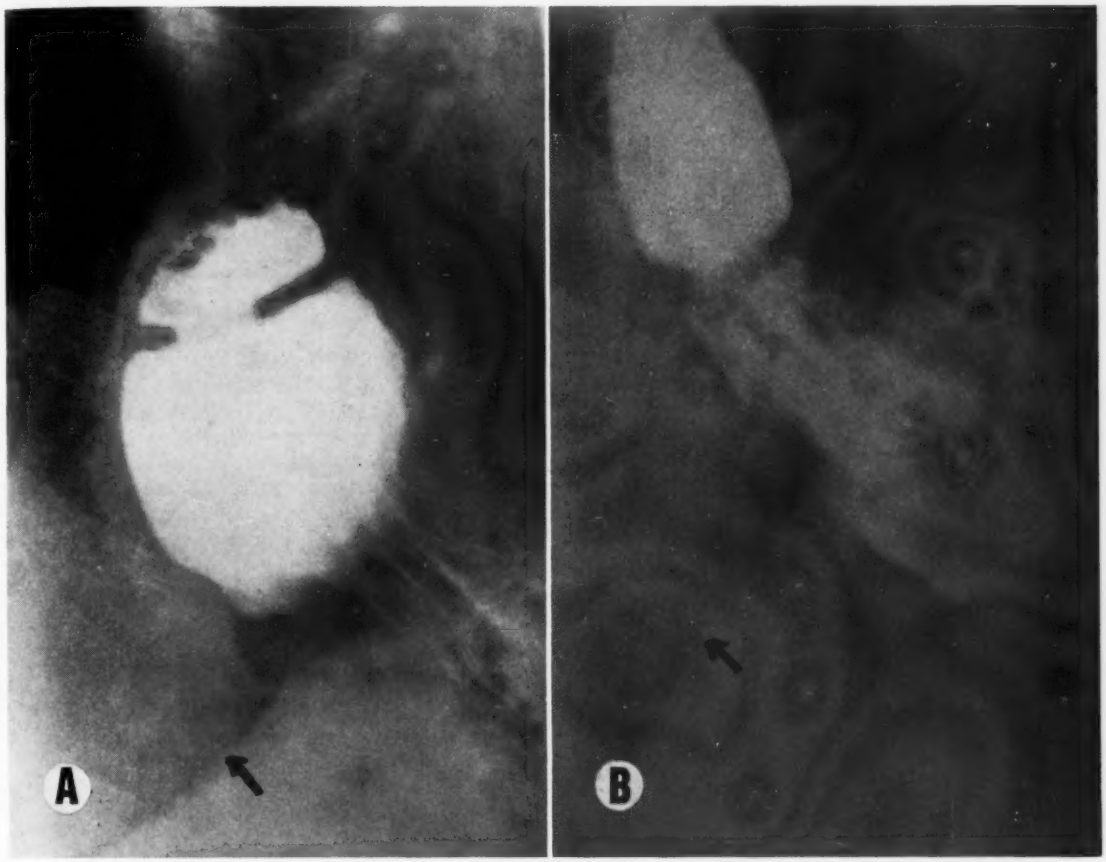


Fig. 8. Case iv. L. R., male, aged fifty-two. Eighteen month history of dysphagia starting with solid food (bread), then aggravated by fluids. Arrows indicate diaphragm. (*A*) Inspiration. (*B*) Expiration. The diameter of the ring remains unchanged although the ballooning in inspiration makes the ring more obvious (see also Fig. 9).

shaped stenosis in cardiospasm. In contrast to cardiospasm, the esophagus above the narrowing appears normal, and finally there is no delay in emptying of the esophagus as seen in cardiospasm. Fibrosis of the lower esophagus, as produced by a healed ulcer or by so-called reflux esophagitis, simulates the ring more than any other lesion and a careful differentiation of the two conditions is necessary. Both lesions are characterized by the presence of a segment of lower esophagus which does not dilate beyond a certain diameter. The ring differs, however, in many respects from the appearance of fibrosis. The narrowing produced by the ring is always symmetrical, and the involved segment is consistently very short, measuring only 2 to 4 mm. in length. In fibrosis, the narrowing is usually asymmetrical, not so short, and normally not of equal length around the circumference of the esophagus. If the ring is wide, as in Case v, it does not appear as rigid as does the scarred esophagus. There is no delay in the emptying of the esophagus.

The combination of all these features produces a similarity of cases with rings which is striking and differs from the fibrosis usually seen after ulcer or reflux esophagitis. Furthermore, endoscopy shows no inflammation, ulcer or scarring.

Location of the Ring

Surgery has proved that, in 1 of our cases, the ring coincided with the herniated esophagogastric junction. Some factors

FIG. 9. Case IV. A bolus of bread is seen to squeeze through the ring (arrows).

FIG. 10. Case V. M. M., male, dentist, aged fifty-one. This patient had a one year history of occasional dysphagia, usually when he ate steak hurriedly. Five and one-half years later symptoms were unchanged. This is the largest ring in our series with symptoms. (*A*) Original observation (18 mm.). (*B*) Five and one-half years later (16 mm.). The two roentgenograms were not quite proportionally photographed. The above figures represent the actual measurements of the diameters of the ring (see also Fig. 11).

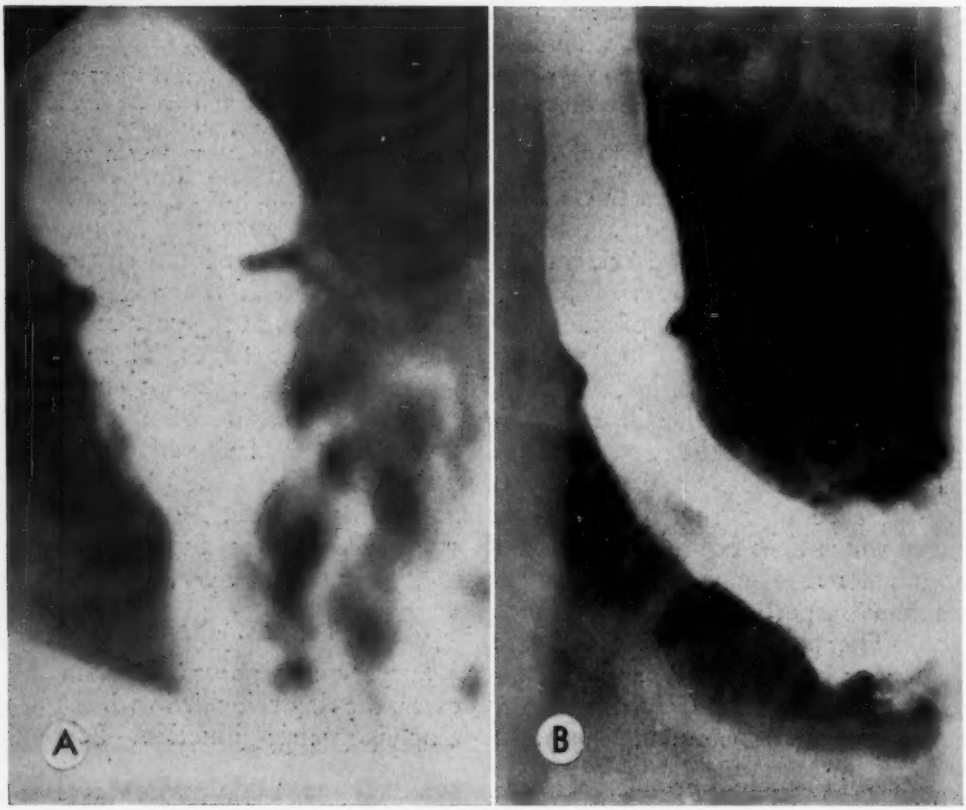
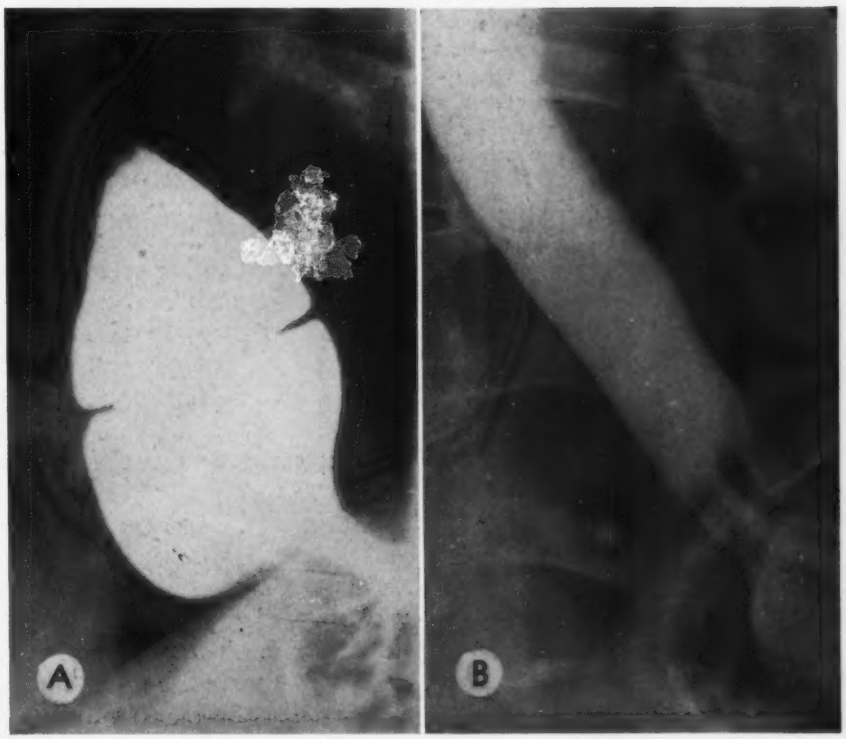


Fig. 11. Case v. The ring is still visible as bread squeezes through it.

Fig. 12. Asymptomatic ring. (*A*) Visible when esophagus is markedly distended during deep inspiration. This could be reproduced at will and the diameter of the ring was always the same. (*B*) Not visible with less filling of the esophagus during quiet respiration because the lumen above and below is not sufficiently dilated to exceed the diameter of the ring.



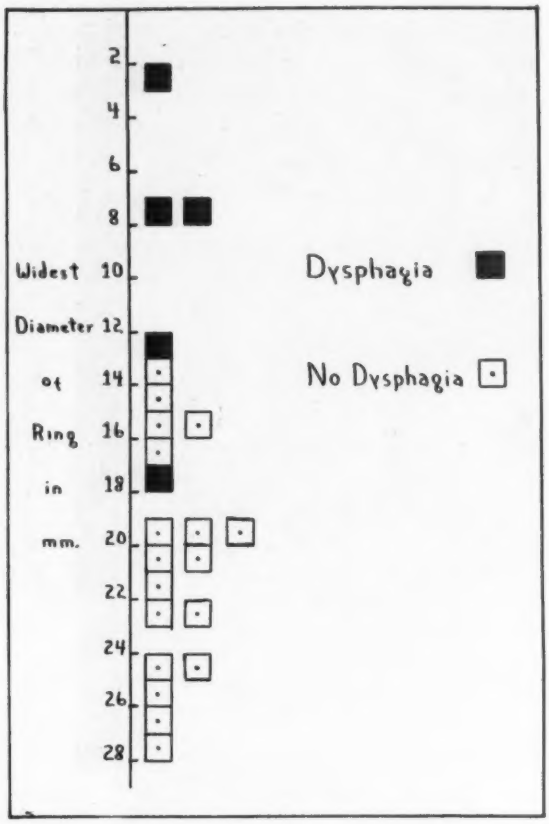


FIG. 13. Chart showing the diameters of the rings in patients with dysphagia, and some of the recent cases without dysphagia. It is not intended that the chart give the relative frequency of symptomatic and asymptomatic cases. We did not record a large number of asymptomatic cases examined in the five and one-half years during which the symptomatic cases were collected.

speak for a similar location in the remaining 4 cases with dysphagia. Roentgenologically, the mucosal folds below the ring were rather wide in all 4, and the esophagoscopist thought he saw gastric mucosa above the diaphragm in 2 of the cases. Furthermore, the lumen below the ring was wider than above the ring in all 4 cases.

On the other hand, no roentgenological suggestion of herniation was present in some of the asymptomatic cases. If we assume that the ring in the symptomatic and asymptomatic cases is produced by a related mechanism, and the striking roentgenological similarity of some of these cases makes it hard to dispute such an assumption, it becomes difficult to proclaim the herniated esophagogastric junction as the site of the lesion in all cases.

At present we do not know whether the ring always lies at this level. It certainly does in some.

PROGRESS OF THE LESION

Very little is known about the onset of the lesion or of any possible later changes. We have had, however, occasion to observe 1 patient for five and a half years and 2 others over a period of three years. One showed a decrease in the size of the lumen from 18 mm. to 16 mm. in the five and one-half year period. Another showed an increase in the size of the lumen from 13

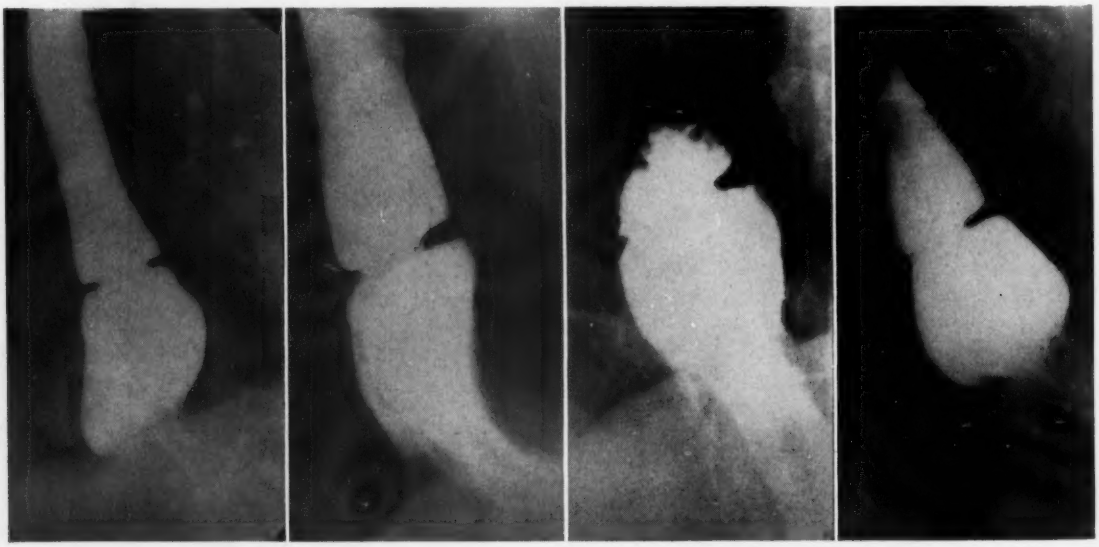


FIG. 14. Four different patients without dysphagia but with constantly demonstrable rings.

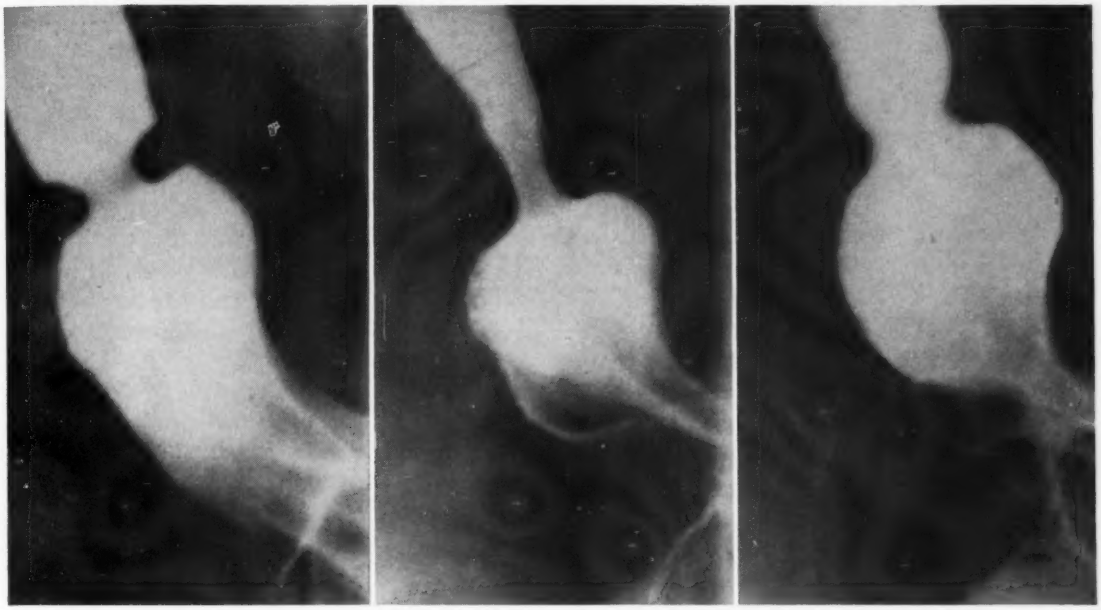


Fig. 15. Contraction in the lower esophagus, not a "lower esophageal ring."

mm. to 15 mm. in three and one-half years, whereas the third showed no change in three years and the lumen remained 8 mm. in diameter. In other words, there were practically no changes over these periods of time in any of the 3 patients. We do not know whether there will be further gradual narrowing of the rings. Our observations lead us to believe that the ring, once present, will not disappear and that, if it has reached a certain diameter which interferes with the passage of a normal bolus of food, the patient's symptoms will persist unless he changes his eating habits.

TREATMENT

The most important feature of treatment is education of the patient. He is made to understand the nature of his difficulty. He is told to avoid pieces of food over a certain size, to chew carefully and to eat slowly. Those of our patients who followed this regimen have had little discomfort. Amyl nitrite, which was tried in 1 of our patients, did not produce any change in the size of the ring. Bouginage of the esophagus, which was done in 2 of our patients, caused no change in the diameter of the ring. The patient with the narrowest ring had a plastic repair of the constriction and is without symptoms four years later. We believe that only in extreme cases will it be necessary to resort to surgical treatment.

DISCUSSION

Unfortunately, we do not know the exact nature of the lesion in the patients under discussion, but there appears little doubt that they do form a group separate from

Fig. 16. Contraction in the lower esophagus, not a "lower esophageal ring."

other cases of dysphagia with a characteristic roentgenological and clinical picture. In this we agree with Ingelfinger and Kramer. Our observations differ, however, from theirs in some significant points. Ingelfinger and Kramer state that, at least in the milder cases, the lesion is not preformed and occurs as a peristaltic wave approaches the lower esophagus, that the ring may become more pronounced following an obstructive episode, and that it may migrate down the esophagus towards the diaphragm. Our observations force us to believe that the ring is fixed in its location in the esophagus, that migration is apparent rather than real, that the ring is present at all times although visible only when the intestinal tube proximal and distal to it is distended more than the maximum diameter of the ring, and that this maximum diameter is definite for each individual case. In contrast to Ingelfinger and Kramer, we have observed that the ring does not narrow down on food, but becomes maximally dilated by it. In other words, in contrast to the active motor phenomenon postulated by Ingelfinger and Kramer, we believe that the ring is a rather passive structure.

For this reason the maximum diameter of the ring is of prime importance. It determines the maximum size of the bolus which can pass through the ring, and the severity of the patient's symptoms. Usually, this diameter can be readily determined by spot roentgenograms of the filled lower end of the esophagus taken during deep inspiration or the Valsalva test. It is more convincing, however, to test this diameter objectively by the use of barium-filled gelatin capsules. The largest available and useful capsule, the ooo capsule, has a diameter of about 1 cm. and will identify any narrowing up to this diameter. In the rarer instances where dysphagia is produced by a wider ring, the passage of solid food may be slowed by the ring, as shown by Ingelfinger and Kramer, and as seen in 2 of our cases. The evaluation of such cases is more difficult, since the size of the bolus necessary to produce clinical symptoms and roentgenological abnormalities is apt to produce some discomfort and delay even in a normal person. Transient contractions of the lower end of the esophagus, which do not show the characteristics of the ring (Fig. 15 and 16), and wide rings, which do not demonstrably block the passage of food, should not be accused of causing clinical symptoms.

SUMMARY

1. Dysphagia caused by a smooth, symmetrical, diaphragm-like narrowing in the lower end of the esophagus is described. This affliction occurred in five adult males.

2. The greatest diameter of this diaphragm or ring is constant in a given person with the exception that it can be slightly stretched as solid or semisolid food passes through it. The position of the ring is constant in a given person.

3. The constancy of the diameter of the ring is best tested with barium-filled gelatin capsules.

4. A similar ring is not too infrequently seen in patients without dysphagia. It is likewise constant in position in a given person, but not quite so constant in diameter.

5. The nature of the ring is not known.

6. Education in eating habits relieves the dysphagia in most cases. An occasional case may require surgical treatment.

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Vol. 70, No. 6

TUBERCULOSIS OF THE RIBS*

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TUBERCULOUS osteomyelitis of the ribs, although of rather infrequent occurrence, is by no means a rare condition. Review of the world literature from 1916 through 1950 disclosed reports of approximately 400 cases (exact tabulation being difficult because of probable duplication of some case reports in several references). Tuberculosis is, thus, by far the most common inflammatory process involving the ribs, apparently exceeding in frequency all other causes combined. Tuberculosis is second only to metastatic malignancy as a cause of destructive lesions of the ribs.

Surprisingly little note is made of the roentgenographic appearance of rib tuberculosis in the many articles reviewed, particularly in those in the English literature. Because of this, and because the diagnosis of rib tuberculosis often presents a considerable problem, a review of cases of rib tuberculosis seen at the hospitals of the Detroit Department of Health (Receiving Hospital, Herman Kiefer Hospital, and Maybury Sanitarium) was undertaken to establish some diagnostic criteria for the roentgenological diagnosis of this condition. A total of 23 cases of rib tuberculosis proved by biopsy, autopsy findings, or bacteriological methods and having adequate roentgenological studies which were seen in the above hospitals during the period 1938 to 1948 (inclusive) form the basis for this study.

INCIDENCE

Statistics as to the incidence of rib tuberculosis vary considerably in reported series, different authors reporting an incidence of anywhere from 1 per cent to 16 per cent among all cases of bone and joint tuberculosis. In our series, rib tuberculosis was found to occur in 5 per cent of all cases of bone and joint tuberculosis, a figure which agrees almost exactly with the incidence found in most of the larger series published (*e.g.*, Morando,[24] in a review of 181 cases of rib tuberculosis). In our group of cases, rib tuberculosis was seen in only 0.1 per cent of all tuberculous hospital admissions and in only 0.008 per cent of all general hospital admissions (1 case per 12,500 admissions).

Rib tuberculosis occurs in males about 2.5 times as often as it does in females. Although cases occur at almost any age (*e.g.*, ranging from ages nine to seventy in our series), the greatest frequency is between the ages of fifteen and thirty-five, as contrasted to most forms of bone tuberculosis which occur with greatest frequency between the ages of two and ten.

As in other forms of bone tuberculosis, active pulmonary tuberculosis or even quiescent reinfection type of pulmonary tuberculosis is not often seen in association with rib tuberculosis. We found only 6 cases of reinfection type pulmonary tuberculosis (4 of which were active) among our 23 cases of rib tuberculosis. Morando[24] found only 8 cases of active pulmonary tuberculosis in his 181 cases of rib tuberculosis.

Other sites of tuberculous bone involvement are seen in association with rib tuberculosis fairly often (in 15 of our 23 cases). Morando,[24] however, reported evidence of tuberculosis of other bones in only 65 of his 181 cases. By far the most common bone lesion associated with rib tuberculosis is tuberculous spondylitis.

Auerbach[2] has reported 8 cases of rupture or extension into lung or pleural space among 31 cases of rib tuberculosis. We have seen only 1 case of pleural involvement on the same side as the rib lesion in our series, although several such cases are reported in the literature.[10,17,27]

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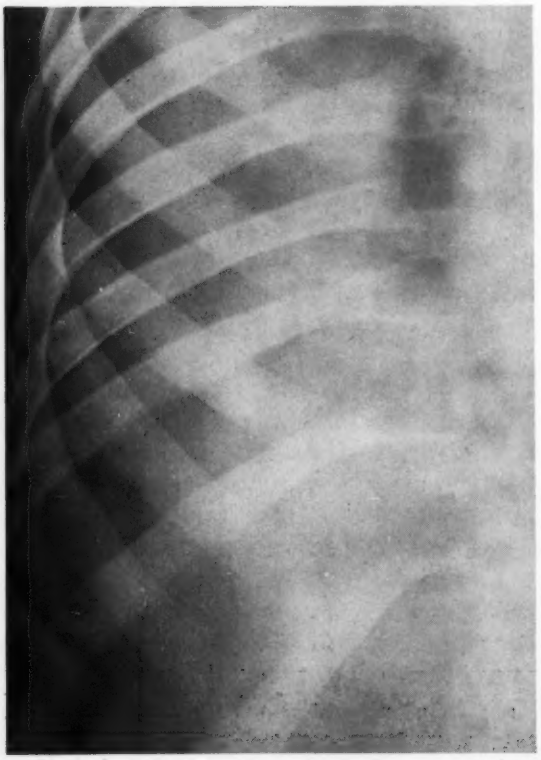

FIG. 1. Case 1. C. J. Costovertebral tuberculosis with destruction of the heads of ribs seven through twelve on the right. Spondylitis of ninth and tenth thoracic vertebrae with paravertebral abscess, not well shown because of empyema on the right.

Patient had right hilar lymphadenopathy with positive sputum for tuberculosis, followed in four months by development of the paravertebral abscess and rib involvement. Four months later a right empyema developed with rapidly retrogressive course, progressing to death eleven months after initial onset of symptoms.

In 6 (25 per cent) of our cases there was no evidence of tuberculosis, active or arrested, in any location other than in the ribs, either during the course of the rib infection, or before or after its appearance. Sjövall[34] reported that 44 of his 75 cases of rib tuberculosis had no other clinical manifestation of tuberculosis, either active or healed.

SYMPTOMS AND CLINICAL FINDINGS

Most cases of rib tuberculosis are seen because of the presence of a mass, usually painful, on the chest wall or because of general symptoms, chiefly temperature elevation and weight loss.[27] In our series, a mass was palpable in 60 per cent of the cases. Pain was present in 50 per cent of the cases, usually with a mass, although 2 cases had localized pain at the site of the lesion with no palpable mass. General symptoms of moderate to severe degree were present in 50 per cent of the cases, mostly in cases with associated active spinal or pulmonary tuberculosis.

The palpable mass is usually cystic or doughy in consistency, although at times it may be quite tense, giving an impression of firmness. The location of the mass is not characteristic, since rib lesions may be

FIG. 2. Case 15. E. J. Irregular subperiosteal destruction of the shafts of ribs ten, eleven, and twelve on the left with minimal involvement of the heads of the ribs, associated with extensive paravertebral abscess covering the entire thoracic region of the spine.

This patient had a left upper lumbar mass developing after an injury, which drained for over a year following incision and drainage. Course was progressively retrogressive to death, twenty-three months after first symptoms occurred. Autopsy revealed caseous tuberculosis of the spleen, kidneys, and multiple lymph nodes in addition to the spine and rib lesions.

found in any rib and in any part of the rib. A draining sinus is said to occur with great frequency, but we have found sinuses in only 25 per cent of our cases. This is a rather late finding and invariably occurs after the appearance of the soft tissue mass.

It should be noted that one of our cases had no symptoms, either local or general, and was discovered accidentally on a routine chest roentgenogram for follow-up of an arrested primary pulmonary tuberculosis. Four other cases had no localizing symptoms or findings and were discovered only because chest roentgenograms were made because of unexplained general symptoms.

ROENTGENOGRAPHIC APPEARANCE

We have divided our cases of rib tuberculosis into four main categories, based primarily upon the part of the rib involved, since we have found that each of these groups differs to a certain degree in roentgenographic appearance and also presents different problems in differential diagnosis. This classification is admittedly arbitrary and is not basically original, since the terms used to designate each class have been used by others, although not as a system of classification of the roentgenographic characteristics.

1. *Costovertebral Involvement.* This was demonstrated in 35 per cent of our cases. This form of rib involvement is invariably associated with tuberculous spondylitis and paravertebral abscess. The rib lesions are always at the levels covered by the paravertebral abscess and the ribs are, therefore,

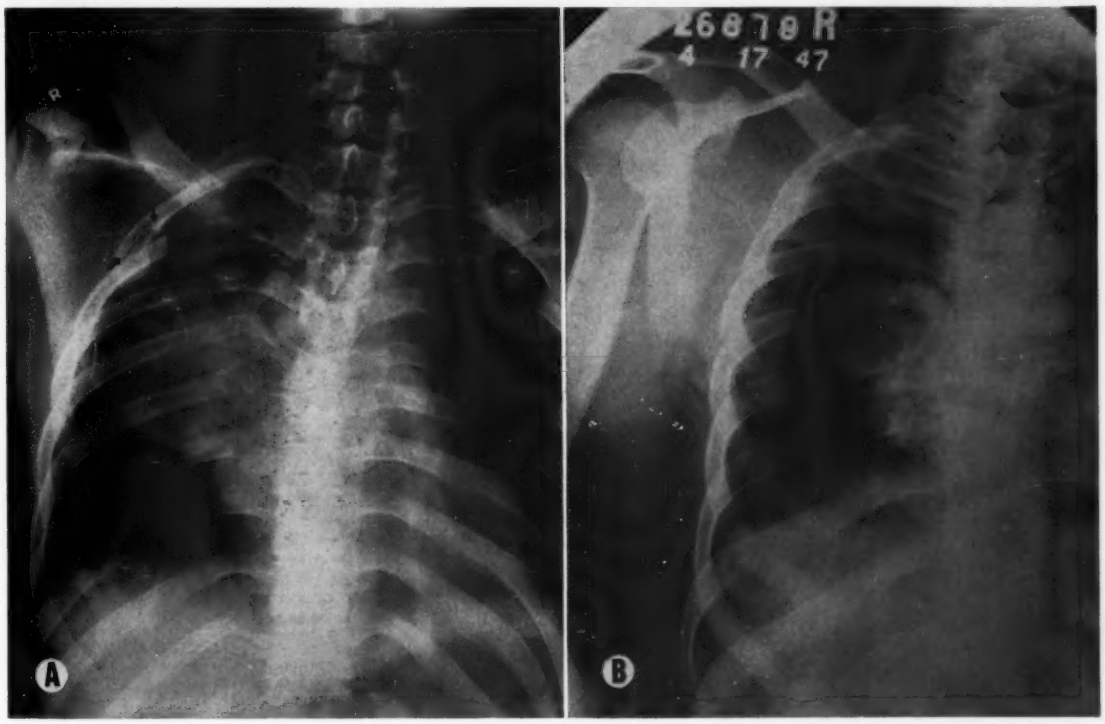

Fig. 3. Case 13. J. R. (*A*) Tuberculous spondylitis of mid-thoracic spine with a large paravertebral abscess, unusually prominent on the right, with destruction of the heads and tubercles of the right fifth, sixth, and seventh ribs. There is a pathological fracture near the tubercle of the sixth rib and superior dislocation of the fifth and sixth ribs. There is an early destructive lesion of the right second rib in the axillary region with small soft tissue mass visible (arrows). (*B*) Two and one-half years later the lesion in the right second rib is completely healed (without specific treatment) and the spondylitis and adjacent rib lesions are much improved after treatment on Bradford frame and spinal fusion. The above lesions were discovered on routine follow-up chest roentgenogram ten years after recovery from primary pulmonary tuberculosis.

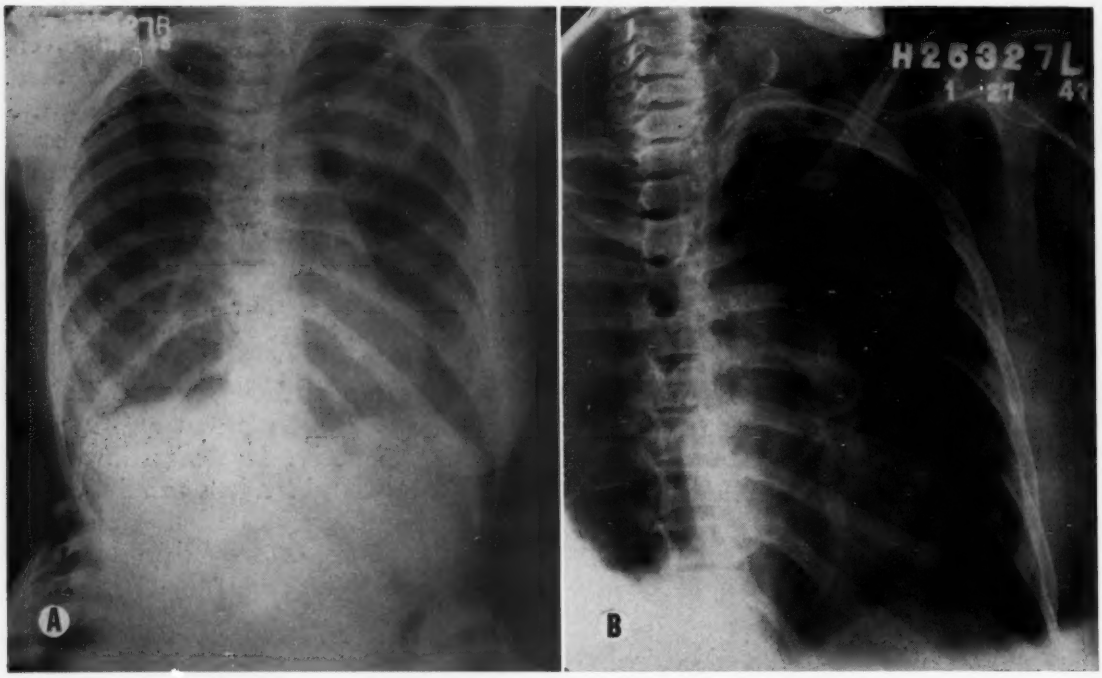

FIG. 4. Case 20. M. F. (*A*) Large soft tissue mass at anterior end of left first rib with complete destruction of anterior end of this rib and slight erosion of the superior margin of the left second rib. (*B*) End result eighteen months following resection of anterior ends of the left first and second ribs, showing some bone regeneration in the area of resection.

This patient had a left anterior chest wall mass and fever for two months. Excision of the mass resulted in a draining sinus. Five months later, after the diagnosis of tuberculosis was established, rib resection was done. Three years later there was no evidence of recurrence.

probably involved by direct extension of the infectious process. There is almost always involvement of more than one rib, on one or both sides.

In general, these cases show evidence of irregular cortical bone destruction, usually localized to the region of the costotransverse joint and/or head of the rib (Fig. 1, 2 and 3), but sometimes extending for some distance laterally along the shaft (Fig. 2). No localized soft tissue mass is seen along the rib (except for the paravertebral abscess itself). In many cases there is complete dissolution of continuity of the rib, particularly in the region of the head, neck, or tubercle, in which case there is frequently evidence of pathological fracture or dislocation at the costovertebral or costotransverse joint (Fig. 3*A*).

Usually this form of rib tuberculosis will offer no serious diagnostic problem from the roentgenological point of view, since the characteristic paravertebral abscess should suggest tuberculosis as the cause of the rib destruction, but rarely other granulomatous infections (coccidioidomycosis, actinomycosis, and blastomycosis) may produce a combination of vertebral and rib lesions very similar in appearance to the costovertebral form of tuberculosis.[6,15,26]

2. *Costochondral Involvement.* This form of rib tuberculosis was found in only 13 per cent of our cases. There is usually only one rib involved in this type.

Roentgenographically, a soft tissue mass of greater or lesser density is seen over the region of the costochondral junction in almost all cases (only one of our cases had no roentgenographically visible mass). There is associated bone destruction of the anterior end of the rib, the extent of the destruction being variable (Fig. 4). The bone destruction is usually complete and quite sharply delimited, without, however, any

zone of sclerosis in the adjacent uninvolved rib. In early cases the area of bone destruction may be so small as to escape detection without special care in examining the roentgenograms and special detail views of the anterior ends of the ribs (Fig. 5).

We have found no cases, either in our own series or in those reported in the literature, of tuberculous chondritis of the costal cartilage without adjacent bone involvement, although Bisgard,[5] in reporting a case of tuberculous osteochondritis of the first rib and cartilage, states that the roentgenograms were negative for several months during the course of the disease despite a palpable mass, but bone destruction was eventually noted. The initial roentgenograms were not reproduced, however. We feel that absence of bone destruction at the costochondral junction will usually eliminate tuberculosis from consideration as the cause of a soft tissue mass on the anterior chest wall.

3. *Shaft Involvement.* Involvement of the rib shaft was found in 61 per cent of our cases. In the majority of cases only one rib was involved.

Several different roentgenographic pictures may be produced in this type of rib tuberculosis, but they probably all represent similar pathologic and morphologic changes, differing only in the stage of the disease process or in the degree of involvement. The lesions apparently begin as small foci of bone destruction (Fig. 6*A*) gradually producing periosteal elevation, soft tissue mass, and increasing bone destruction (Fig. 6*B*).[10,21] The early stages are rarely seen, since symptoms are absent or minimal until rib destruction is fairly advanced.

Most commonly, by far, the roentgenogram shows evidence of complete destruction of a segment of rib with sharply defined margins at the edges of the destroyed area. A visible soft tissue mass, quite dense and sharply demarcated, is almost always present about the area of bone destruction (Fig. 7). This picture would appear to represent a fairly advanced process.

Fig. 5. Case 7. McK. F. Poorly defined soft tissue mass (black arrows) associated with destruction of the anterior end of the left fifth rib. There is also a slightly expanding, destructive lesion of the left ninth rib with appearance suggesting a pathological fracture (white arrows).

These lesions were discovered in investigation of two masses on the anterior left chest wall with draining sinus which had developed nine months after the appearance of the mass. There was also an early tuberculous spondylitis of the ninth and tenth thoracic vertebrae. Diagnosis was confirmed by culture of material from the draining sinus. Patient was transferred to a tuberculosis sanatorium but never arrived there, and was lost to follow-up.

Evidence of calcification within the soft tissue mass is seen very rarely. Only one reference in our review was found to mention calcification in the soft tissue mass,[21] and we have seen this in only one of our cases (Fig. 8). We do not feel, however, that absence of calcification can be relied upon to aid in the diagnosis, although presence of calcification in the soft tissue mass makes the diagnosis of tuberculosis much less likely.

Much less often, the shaft involvement is manifested as a mottled, irregular area of bone destruction, usually involving only a very short segment of the rib, apparently a fairly early stage of the disease. In this type of lesion, the soft tissue mass is quite small or may even be absent (Fig. 3*A* and 6*A*).

Quite uncommonly, the rib destruction

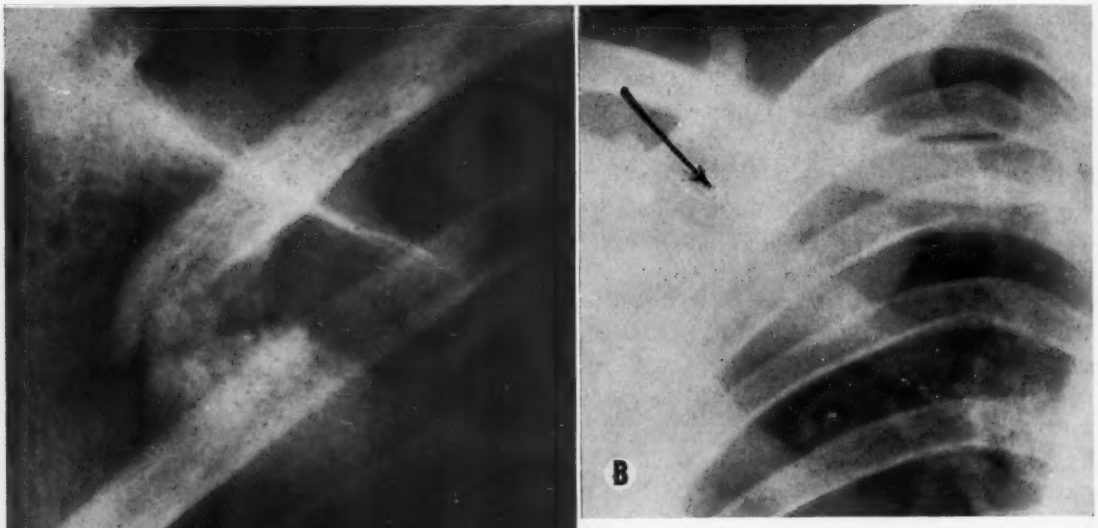

FIG. 6. Case 2. F.G. (*A*) Enlarged reproduction of irregular, early bone destruction in right second rib. (*B*) Large soft tissue mass has developed one month later with some increase in the bone destruction (not well visualized on the reproduction).

This lesion was first discovered in a young male being studied for pain in the knee. Roentgenograms of the knee showed only soft tissue swelling, but studies of the spine revealed tuberculous spondylitis and paravertebral abscess in the lower thoracic region. Patient died after six months' treatment on a Bradford frame.

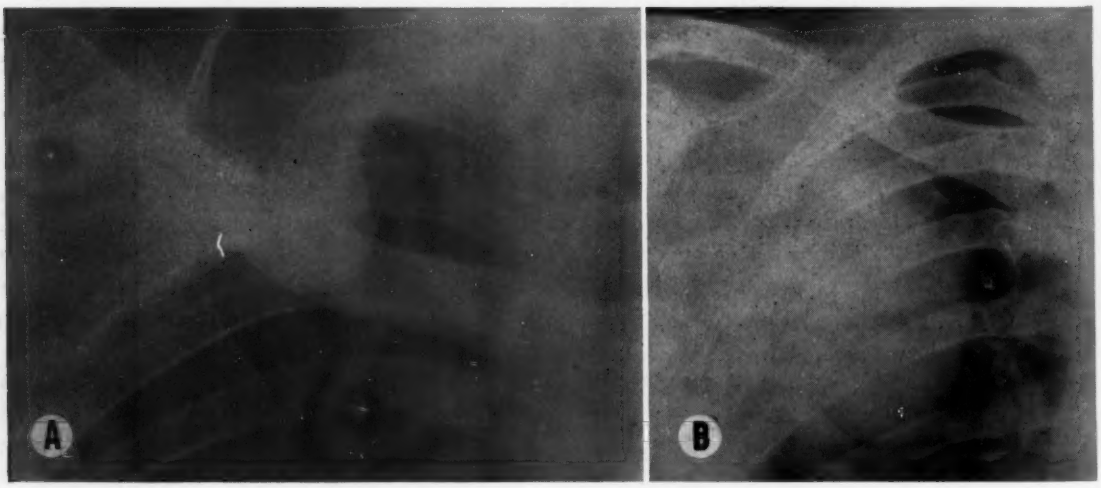

FIG. 7. Case 18. R. J. (*A*) Complete destruction of a segment of the right second rib with associated intrathoracic soft tissue mass. This patient had miliary tuberculosis (pulmonary), which is poorly visualized on this reproduction, and died two months later with tuberculous meningitis.

(*B*) Case 1. E. L. Large soft tissue mass with complete destruction of anterior half of right second rib. The diagnosis of tuberculosis was established by culture of material aspirated from the mass, but treatment was refused and patient was lost to follow-up.

may be limited to a more or less smooth concave defect on one margin of the rib shaft, sometimes having a scalloped appearance. A visible soft tissue mass is usually present (Fig. 4*A* and 9).

Expansion of the cortex was seen in only one of our cases (Fig. 5), and this was probably associated with pathological fracture. Other authors,[17,21] however, report an occasional lesion producing cortical expansion and being somewhat cystic in appearance, but this is apparently very rarely encountered. We found no cystic rib lesions except in the special category of Group 4 (*cf.* below).

We have found only one case of pathological fracture in tuberculosis of the rib shaft (Fig. 5), and only an occasional case report of pathological fracture is found elsewhere.[11,17,32]

It should be noted that in none of these cases have we detected evidence of productive bone change, which is, therefore, consistent with the usual course of bone tuberculosis in other regions.

4. *Multiple Cystic Bone Tuberculosis.* Although these lesions are essentially a form of shaft involvement when they involve the ribs, we have placed them in a separate category because of the multi-

Fig. 8. Case 22. L. O. Extensive destruction of the posterior segment of the left third rib with intrathoracic soft tissue mass containing small flecks of calcium in its lower portion. The diagnosis of tuberculosis was confirmed by biopsy and the rib was resected. Patient was well for over one year follow-up.

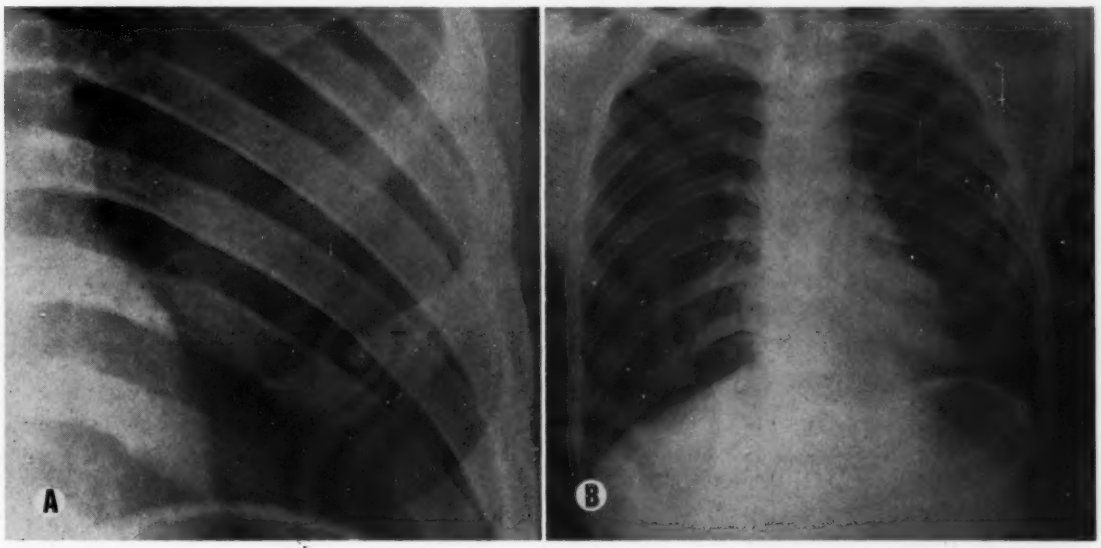

Fig. 9. Case 6. J. O. (*A*) Irregular destruction, somewhat scalloped in appearance, of inferior border of the left fourth rib anteriorly associated with a poorly defined soft tissue mass. (*B*) Eight months later the soft tissue mass has resolved and the rib has regenerated after a course of streptomycin therapy.

This patient also had two destructive lesions in the body of the right scapula with draining sinuses and a proved tuberculous lesion of the upper esophagus which produced partial obstruction and perforation into the upper mediastinum. These lesions also healed with the same therapy.

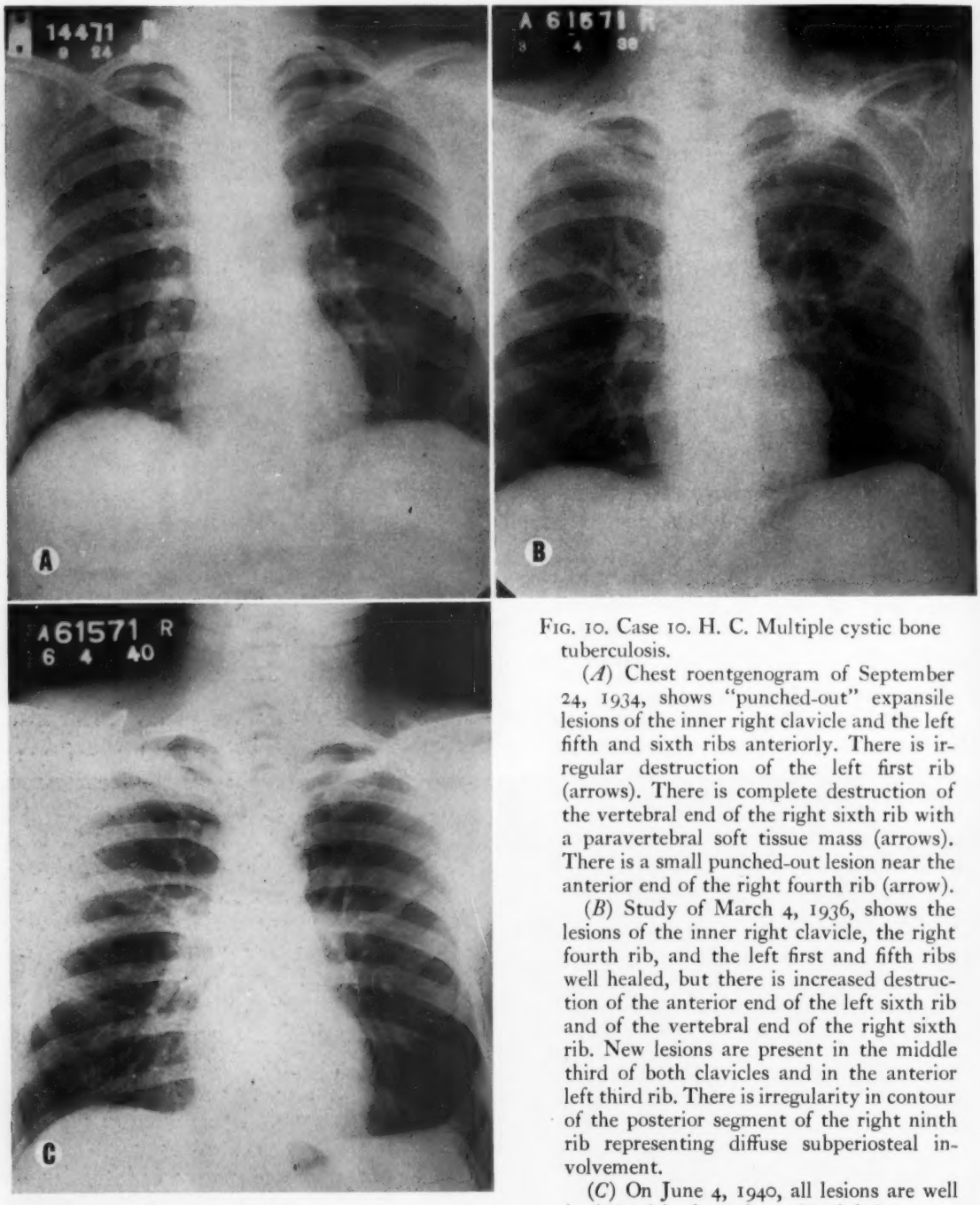

FIG. 10. Case 10. H. C. Multiple cystic bone tuberculosis.

(*A*) Chest roentgenogram of September 24, 1934, shows "punched-out" expansile lesions of the inner right clavicle and the left fifth and sixth ribs anteriorly. There is irregular destruction of the left first rib (arrows). There is complete destruction of the vertebral end of the right sixth rib with a paravertebral soft tissue mass (arrows). There is a small punched-out lesion near the anterior end of the right fourth rib (arrow).

(*B*) Study of March 4, 1936, shows the lesions of the inner right clavicle, the right fourth rib, and the left first and fifth ribs well healed, but there is increased destruction of the anterior end of the left sixth rib and of the vertebral end of the right sixth rib. New lesions are present in the middle third of both clavicles and in the anterior left third rib. There is irregularity in contour of the posterior segment of the right ninth rib representing diffuse subperiosteal involvement.

(*C*) On June 4, 1940, all lesions are well healed with the only residual being some irregularity of the anterior left third rib, some narrowing of the posterior right sixth rib, and loss of most of the anterior end of the left sixth rib.

This patient had, over a five year period, multiple similar "cyst-like" destructive and usually expansile lesions of the lower right radius, left humerus, both femurs, lower right tibia, and skull. Biopsy of the lesion of the right radius showed a typical caseating tuberculosis. There were many draining sinuses of the chest wall at the sites of many of the rib lesions from time to time. All lesions healed on supportive treatment with apparent complete arrest of all lesions during the last one and one-half years of observation.

plicity of bone lesions as well as the rather characteristic roentgenographic appearance. The general characteristics of this type of bone tuberculosis will not be considered here since the single case of this form of tuberculosis seen in our series of rib tuberculosis will be reported elsewhere in detail.

The rib lesions in this condition are quite similar to the other bone lesions of multiple cystic tuberculosis. The characteristic lesion is represented by an oval area of bone destruction surrounded by a fairly distinct zone of bone sclerosis with evidence of some expansion of the shaft. The rib lesions are multiple and show evidence of varying stages of development. In our case, some lesions progressed to complete destruction of a considerable segment of rib while other lesions regressed more or less completely (Fig. 10).

It will be noted that the percentages given above total more than 100 per cent. This is explained by the fact that 3 cases exhibited two different forms of rib involvement each.

DIFFERENTIAL DIAGNOSIS

As in any diagnostic problem, careful evaluation of the clinical history and physical findings, plus any special laboratory tests, such as serologic tests, agglutinations, and skin tests for certain specific infectious diseases, may aid considerably in the differential diagnosis. When the diagnosis is still in doubt, needle biopsy is of great value for both bacteriologic and histopathologic studies, and should be attempted before formal biopsy or rib resection is contemplated.

As suggested previously, the costovertebral form of tuberculosis is fairly characteristic in its roentgenographic manifestations, but occasional cases of coccidioidomycosis involving the spine with direct extension to the ribs have been reported,[6] and several cases of blastomycosis of the spine with paravertebral abscess and adjacent rib destruction bearing a striking resemblance to costovertebral tuberculosis have also been described.[33] A positive skin test for coccidioidomycosis or the presence of chronic skin lesions of blastomycosis may indicate the diagnosis.

Actinomycosis may also produce spine and rib lesions with a paravertebral abscess similar to tuberculosis, but the spine lesions differ in that actinomycotic lesions usually involve all parts of the vertebra rather than the body alone as does tuberculosis, and, furthermore, vertebral collapse and intervertebral disc destruction, commonly seen in tuberculous spondylitis, is almost never found in actinomycosis.[18,26]

Tuberculous lesions of the rib shaft present the greatest differential diagnostic problem, since any destructive process may simulate rib tuberculosis. The most common lesion which may cause difficulty in this respect is the solitary metastatic neoplasm. We have seen cases of metastases from primary carcinoma of liver (Fig. 11), breast, thyroid, and kidney produce solitary destructive rib lesions with visible

Fig. 11. Patient E. U. Destruction of large segment of right tenth rib associated with definite soft tissue mass (arrows). Biopsy revealed malignancy with typical appearance and arrangement of liver tissue. Patient died several months later and primary hepatoma was found at autopsy.

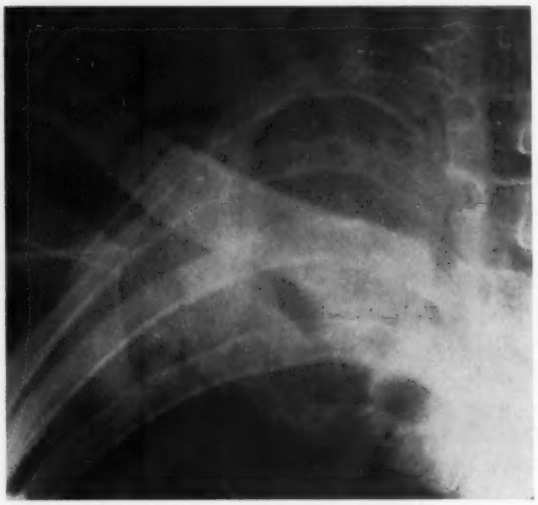

FIG. 12. Patient E. Y. Extensive consolidation of right upper lobe associated with pleural thickening and irregular destruction of the adjacent posterior segments of the right second and third ribs. Resection of the involved ribs revealed typical ray fungi of actinomycosis. Autopsy one month later showed only actinomycosis with no evidence of tuberculosis.

soft tissue masses which mimicked the comparable form of tuberculous lesion exactly from the roentgenographic standpoint. The clinical history, search for possible primary tumor, the patient's age, and search for other lesions of malignant or tuberculous nature in other parts of the body may help in the diagnosis, but some cases are solved only after needle biopsy.

Multiple rib metastases and multiple myeloma should offer no difficulty except possibly in differentiation from the multiple cystic form of tuberculosis, but even here the fairly large expanding lesions of cystic tuberculosis should not be easily confused with these malignant lesions.

Certain specific infectious processes, though rarely involving the ribs, may occasionally produce roentgenographic findings closely simulating rib tuberculosis in one of its variable forms:

Typhoid or paratyphoid (*Salmonella*) osteomyelitis of the rib is very similar in roentgenographic appearance to tuberculosis. Rib lesions in these diseases, however, follow quite closely on the heels of the acute generalized infection, so that the history should point the way for utilization of proper agglutination tests, which will confirm the diagnosis.[23,36]

Pyogenic osteomyelitis of the rib is usually caused by the staphylococcus or, less often, by the pneumococcus, streptococcus, and colon bacillus. The rib lesions may resemble tuberculosis closely, with irregular bone destruction and soft tissue abscess. The course, however, is that of an acute process, and the rib lesions almost always follow an exanthematous disease.[33]

Actinomycotic lesions of the ribs (and of the spine) almost invariably occur by direct extension from adjacent soft tissue infection, chiefly from the lung or pleura (Fig. 12). The rib lesions tend to show evidence of productive change as well as bone destruction, although this finding is not constant. Draining sinuses with characteristic "sulfur granules" in the discharge make their appearance early and tend to be multiple.[18]

Blastomycosis involves bone rarely, and then almost always in the disseminated form of the disease. The skin lesions and, frequently, atypical forms of pulmonary infection of blastomycosis may sometimes be confused with tuberculosis. The typical fungi should be sought in the skin lesions and sputum. Some of the reported rib lesions[31] are indistinguishable roentgenologically from tuberculosis, but other reported cases[15,31] showed multiple rib lesions with marginal areas of destruction.

Coccidioidomycosis has been reported by Carter[6] as involving the ribs in a very few cases. These lesions tend to be multiple in the ribs and the bone destruction is marginal, which is unusual in tuberculosis. Soft tissue masses and draining sinuses are not found with coccidioidomycosis.

Brucellosis involves bone with exceeding rarity. The spine is the chief site of bone localization. We have found only one case of rib involvement reported.[16] Roentgenograms were not reproduced, but, from the description presented, the process was apparently similar to rib tuberculosis. Clinical history and agglutination tests should help make the diagnosis.

Torula histolytica infection is quite uncommon, and bone involvement is rare. However, there have been 2 cases reported[7,8] with rib involvement which appeared similar to rib tuberculosis roentgenographically. A soft tissue mass was present in both cases. Aspiration of gelatinous material from the lesion should arouse suspicion of torulosis which may be confirmed by identification of the organism bacteriologically.

Sporotrichosis is also uncommonly seen in bone, and the ribs are only rarely involved. In only one case report[1] were rib lesions mentioned, but no roentgenograms of the rib lesions were reproduced. The lesions were multiple, and apparently similar to those of blastomycosis and coccidioidomycosis as described above. The presence of skin lesions should suggest this possibility also.

Other infectious or inflammatory lesions which rarely involve the ribs probably do not resemble tuberculosis as closely as many of the above, but should be included in this discussion for the sake of completeness:

Syphilis involves the ribs with exceeding rarity, but gummatous lesions may resemble costochondral tuberculosis since most reported cases involve the costal cartilage and anterior end of the rib, with production of soft tissue mass and draining sinuses. The roentgenographic appearance differs, however, in that syphilis produces irregular bone rarefaction associated with some productive bone change and localized periostitis.[12,25]

Yaws occasionally involves bone, but only one case of rib involvement has been described in the literature.[19] The bone lesions are almost always multiple and the skin lesions are characteristic. The geographic distribution of this disease makes it of little importance in temperate climates.

Echinococcus (hydatid) cysts occur very infrequently in the ribs. They usually produce multiloculated cystic lesions of varying size, and only late do they break through the cortex to produce soft tissue masses. When a soft tissue mass is present, there is usually evidence of calcification, which is rarely found in the masses associated with rib tuberculosis.[14,22,30]

Nonspecific osteitis of the rib is a rare condition of unknown etiology which is manifested by irregular areas of rarefaction involving the rib shaft accompanied by marked periosteal activity. The periosteal activity and lack of soft tissue mass should differentiate this from tuberculosis. There is usually a rather prolonged course with tendency to spontaneous healing.[29]

Radiation osteitis produces lesions which are usually painless, even in the presence of pathological fracture. History of roentgen therapy over the site of rib involvement two to four years previously will indicate the etiology of the irregular rib destruction.[28]

Eosinophilic granuloma has involved the ribs in only a few of the reported cases of this condition. There is usually irregular bone destruction with slight cortical expansion associated with localized pleural thickening.[20] The presence of other bone lesions having the characteristic appearance of this disease will aid in pointing to this possibility in the diagnosis.

Malignant tumors of the rib are quite uncommon, but occasionally they resemble rib tuberculosis closely enough to be considered in the diagnosis. As in metastatic malignancy, needle biopsy may be required to establish the diagnosis.

Ewing's sarcoma is the most common primary malignant tumor of the rib. This lesion occurs almost always in children near puberty and almost always in the posterior segment of the rib. There is irregular bone destruction and periosteal elevation usually associated with a large, lobulated soft tissue mass.[4]

Fibrosarcoma of the rib may show complete bone destruction with a large soft tissue mass definitely resembling rib tuberculosis.[35] Solitary myeloma of the rib closely resembling tuberculosis has been reported.[3] Lymphoma, osteogenic sarcoma, and unclassified sarcoma of the rib have been reported[9,35] and sometimes resemble rib tuberculosis in the type of rib destruc-

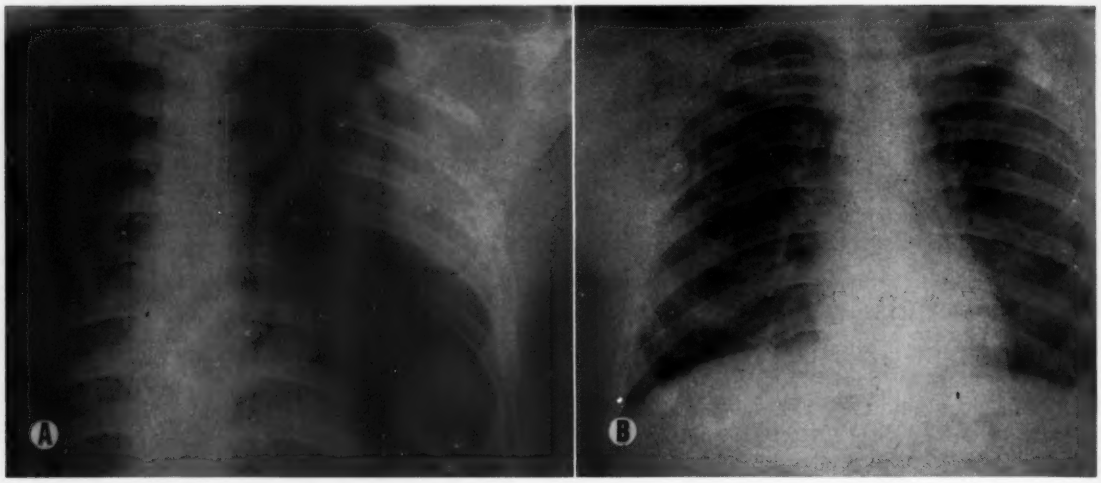

FIG. 13. Case 5. H.W. (*A*) Large soft tissue mass in the left axilla with destruction of a segment of the left third rib proved to be tuberculosis. (*B*) One year later, eight months after rib resection plus streptomycin therapy, there is evidence of the rib resection, but no recurrence of the tuberculosis.

tion and presence of soft tissue mass, but the case reports are so few and the roentgen picture so variable that it is difficult to arrive at any definite diagnostic criteria.

Other tumors and tumor-like lesions including osteochondroma, fibrous dysplasia, giant cell tumor, nonossifying fibroma, hemangioma, Ollier's dyschondroplasia, osteitis fibrosa cystica, and other similar conditions produce expanding tumors of the rib, often with trabeculation and septation and should not, therefore, offer difficulty in differentiation from tuberculosis.

TREATMENT

In almost all cases of rib tuberculosis except the costovertebral form and those cases associated with active pulmonary or systemic tuberculosis resection of the involved rib segment is the treatment of choice. Sjövall[34] has reported treatment results in 75 cases, with approximately 70 per cent cures by rib resection (either primary resection or resection after failure of other less radical surgical methods). These cases were treated before the advent of streptomycin, the use of which as adjuvant therapy preoperatively and postoperatively should improve these results.

In our series of 23 cases, only 9 could be considered suitable cases for rib resection by the above criteria. Of this number, 4 had rib resection (plus streptomycin in 3 cases). All 4 were healed and continued to be well six months to three and one-half years later (Fig. 4 and 13). The other 5 cases received no specific treatment and were lost to follow-up. Several cases with active tuberculosis in other parts of the body did not have rib resection but healed spontaneously or with the use of streptomycin alone (Fig. 3 and 9).

SUMMARY

1. Tuberculosis of the ribs is rather uncommon, comprising about 5 per cent of all cases of bone and joint tuberculosis, but less than 0.1 per cent of all forms of tuberculosis.

2. As in other forms of bone tuberculosis, tuberculosis of the ribs is almost purely destructive. Local soft tissue mass (actually a "cold abscess") is quite common as is local pain, and draining sinus may follow the appearance of the soft tissue mass. The roentgenographic appearance is quite variable, depending on the location of the rib lesion and the degree and stage of its development.

3. Differentiation from other causes of rib destruction is sometimes quite difficult, particularly in the case of many infectious processes (which are, fortunately, exceedingly rare) and solitary osteolytic rib me-

tastases. Needle biopsy is suggested as a means of arriving at a diagnosis in obscure cases.

4. The treatment of choice for rib tuberculosis is surgical resection combined with streptomycin, provided there is no active pulmonary, vertebral, or systemic tuberculosis.

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SKELETAL TUBERCULOSIS

A ROENTGENOGRAPHIC SURVEY WITH RECONSIDERATION OF DIAGNOSTIC CRITERIA*†

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THE material presented in this report encompasses an analytical study of 156 cases of bone and/or joint tuberculosis followed in this hospital in the last ten years. We wish to stress that this analysis is primarily a review of skeletal tuberculosis with particular emphasis on the more unusual roentgen manifestations, many of which have received little mention in the past. Since our findings are in sharp conflict with the classically accepted concepts of the characteristic roentgenographic appearance of osseous tuberculosis, their consideration is justified. The prime purpose of this presentation, therefore, is to document in detail the unique and little known osseous aspects of this disease and to illustrate their extreme morphologic variability and relatively frequent occurrence. Most of the cases to be studied show either conclusive proof (biopsy, smear or culture) or strongly presumptive evidence of this disease. The few remaining cases were diagnosed as tuberculosis on clinical grounds and so treated.

In instances of multiple skeletal lesions, a proved biopsy or culture from any single osseous lesion is herein considered definitive proof of the tuberculous character of the bone disease. It should be noted that surgical principles most often interdict any effort to obtain histological proof of the disease of the spine, in the presence of suspected tuberculosis.[5]

The Skeletal Lesions have been catalogued as follows:

I. Axial tuberculosis (spine and pelvis).
II. Rib tuberculosis.
III. Disseminated osseous tuberculosis.
IV. Peripheral osseous tuberculosis.

I. AXIAL TUBERCULOSIS

A. Cervical Spine Tuberculosis (*Table* 1).

There were 9 cases of tuberculosis of the cervical spine, with principal involvement of the second, fifth, and sixth cervical segments.

Six Negroes, 1 Puerto Rican and 2 white patients were included. Four of these cases were definitely proved and 5 presented strongly presumptive evidence of tuberculosis. The bone lesions were uniformly destructive (lytic) in appearance. The roentgen appearance of these cervical lesions does not differ from traditional teaching and therefore a single representative instance has been selected for presentation.

Classical Lytic Tuberculous Lesions of Cervical Spine

CASE 1. In successive yearly intervals, this twenty-six year old Negro male developed a destructive dorsal spine lesion for which an extensive dorsolumbar fusion was done, a right epididymitis treated by excision, a mixed destructive and eburnated lesion of the right sacroiliac joint, collapse of the third and fourth cervical vertebrae with destruction of the corresponding disc space (Fig. 1) and finally, a lytic lesion of the carpometacarpal joint of the right thumb. At no time was a clear bacteriologic proof of the nature of the disease obtained. This case is therefore considered as tuberculous on the basis of strong presumptive clinical and roentgenographic evidence.

B. Dorsolumbar Spine Tuberculosis (*Tables* II *and* III).

Morphologically and roentgenographi-

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† Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the authors are the result of their own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

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TABLE I

ANALYSIS OF CERVICAL SPINE LESIONS

No.	Race	Level	Type	Drainage or Abscess	Other Axial	Assoc. Skeletal	Assoc. Systemic	Proof	Sputum Urine
1	N	C_{3-4}	L		D_{12-L1}	Rt. 1st metacarp. phal. jt.	G.U.		
2	W	C_{5-6}	L				Tbc. men., Bil. pulm.		
3	P.R.	C_3	L	Bilat. cerv.	D_{3-5}	rt. ulna, lt. 5th rib, rt. kn.	Rt. pl. eff.	P.M.	
4	N	C_{5-7}	L	Yes	D_{7-8}		F.A. bilat. cav. pulm.		+
5	N	C_2	L	Yes		2 rt. ant. cost. cart. adj. rib		+asp.	
6	W	C_2	L	Yes	L_{2-3}		Liver, spleen	+liv. bi., +bone	sm.
7	N	C_2	L	Yes			Rt. pl. eff., Peric. eff.		
8	N	C_{5-6}	L	Yes	D_{8-9}	Lt. wrist		+lt. wr.	
9	N	C_{5-6}	L		D_{12-L1}, L_{3-4}				

cally, the tuberculous lesions involving these two segments of the spine are indistinguishable. They will therefore be considered together. Moreover, the technical reproducibility of dorsal spine studies is considerably less feasible than those of the lumbar spine. For this reason, most of the illustrations prepared to demonstrate representative changes common to both segments are of the dorsolumbar or lumbar areas. Individual statistical analyses for the dorsal and lumbar spine are appended below.

The lesions encountered in this group may be classified as lytic, productive, mixed, and finally, proliferative. Parenthetically, we would like to indicate that considerable disagreement exists as to the most appropriate terminology in the case of productive changes. We accept productive, eburnative and blastic as synonymous and use them interchangeably.

1. *Lytic Lesions of the Dorsal and Lumbar Spine*

The usual appearance of the destructive lesions of tuberculous spondylitis is well recognized. Of far greater interest, however, are those lytic processes which are entirely bizarre and possess few or none of the universally accepted roentgen criteria of tuberculosis. In our experience, these unusual, lytic manifestations may vary widely in appearance and may occur as circumscribed, radiolucent defects, solitary or multiple, localized to a single vertebral body. More rarely, they may appear as large geographic defects, involving one or more centra. These foci may be accompanied by other roentgen stigmata of the specific disease process, such as destruction of the intervertebral disc space or paravertebral abscess at the corresponding segment of involvement, or by additional, more classically described bony lesions at more remote levels. In some instances, however, tell-tale concomitant lesions are absent and extreme difficulty exists in establishing a diagnosis. The need for consideration of tuberculosis as a possible etiology in any case of a destructive spine lesion of undetermined origin is emphasized by the extreme variability of the presenting lesions as revealed in our series.

TABLE II

ANALYSIS OF DORSAL SPINE LESIONS

No.	Race	Level	Type	Drainage or Abscess	Other Axial	Assoc. Skeletal	Assoc. Systemic	Proof	Sputum Urine
1	W	D6–11	L	Yes			Rt. kidney	+Sm.	+
2	N	D11–12	L	Yes			Prostate	P.M.	
3	W	D6–7	L				Bilat. pl. effusion		
4	W	D5–11	B				Far. adv. pulm. dis.		+
5	W	D12–L1	L				Cavitary pulm. dis.		
6	W	D7–L1	L				Bilat. pulm. dis.		+
7	W	D11	B	Yes			Bilat. pulm. dis.	+Sm. aspir.	++
8	P.R.	D3–5	L	Yes	C-3	Rt. ulna, rt. knee, lt. 5th rib	Rt. pl. effusion	P.M.	
9	N	D11–12	L			2 ribs	Miliary terminal		++
10	N	D5–6–7	M		L1–2–3				
11	W	D11–12	M	Yes	L1–2–3			+Sm.	
12	W	D11–12	L	Yes	L1–2				
13	W	D9–10	L						
14	W	D11–12	L						
15	N	All vert.	B			Sacroiliac, 3rd rib	Bilat. basilar inf.	Cerebral removed	
16	N	D10–11, D6–7	L	Yes	9–10–11 ribs, lt.		+dr. from dr. sinus		
17	W	D5–9	L	Yes					
18	W	D9–10	L	Yes					
19	P.R.	D11–12	L	Yes					
20	W	D8–9	L	Yes			Pulm. inf. RLL		
21	W	D10–12	L			Lt. wrist, lt. foot, rt. elbow			
22	N	D11–12	L	Yes			Rt. apical dis.		+
23	N	D6–7, D9–10	L	Yes	L4–5, S1			+dr. guin. pig	
24	W	D11–12	L		L1	Sacroiliac, lt.		Tbc. cult. fr. asp. lt. S.I.	
25	N	D7–8	L			Rt. sacroiliac	Min. infil. RUL	+cult. sp. fl.	
26	W	D-12	B		L1–2		Bilat. pulm. inf. rt. ren. tbc.		+
27	W	D9–11	L		L3–4		Renal tbc.		+
28	W	D10–11	L						
29	W	D11–12	L	Yes			Rt. renal tbc. bilat. pulm.		++
30	W	D6–8	L	Yes					
31	W	D9	L	Yes		Rt. sacroiliac	Renal tbc.+		

Table II—*Continued*

No.	Race	Level	Type	Drainage or Abscess	Other Axial	Assoc. Skeletal	Assoc. Systemic	Proof	Sputum Urine
32	N	D7–8	B	Yes			Rt. epidid. tbc. lt. pl. effusion	Guin. pig. inoc.+	
33	W	D4–D8	L	Yes	L1–3				
34	W	D3–4, D–11	L					+ drain.fr. back	
35	W	D11–12	L		L2			biopsy	
36	W	D6	B						

Solitary Circumscribed Lytic Lesion Occurring as a Unifocal Osseous Manifestation

Case 2. This thirty-one year old American Indian, with involvement of the lower dorsal spine, presented a marked paravertebral abscess at the time of his admission. Smear and culture of the material draining from the abscess showed tubercle bacilli. His disease disseminated rapidly thereafter and the patient died soon after admission with tuberculous meningitis and evidence of involvement of the prostate and seminal vesicles.

Figure 2 demonstrates a well defined circumscribed area of destruction involving the 11th dorsal body. Only minimal changes are noted in the disc space between D11 and D12.

Circumscribed Lesion Occurring in the Presence of Known Osseous Tuberculosis at a More Remote Level

Case 3. A thirty-nine year old Chinese male was first studied for pain in the lower back without demonstrable disease. He later developed a swollen left epididymis from which tubercle bacilli were obtained by aspiration and culture. Thereafter, osseous lesions were discovered in the right sacroiliac joint, as well as in the spine at the levels D9–D10 and L1–L2. Ultimately, widespread pulmonary disease occurred.

Figure 3*a* indicates the presence of a paravertebral abscess extending from D8 to D12 with narrowing of the intervertebral space between D8 and D9.

Figure 3*b* reveals a discrete cystic lesion in the centrum of D12 and narrowing of the interspace immediately below. Slight, but definite increase in bone density of the two centra is apparent, best observed about the superior border of L2.

Multiple Circumscribed (Cystic) Lesions of Vertebrae

Case 4. This patient, aged twenty-seven, Negro, was admitted in January, 1948, for convulsive seizures of an undetermined nature. He was discovered to have high temperatures and drenching sweats. A roentgenogram of the chest revealed a large right hilar density (Fig. 4*a*). In November, 1948, a craniotomy was performed and a tuberculoma in the left premotor area was excised. This diagnosis was established by biopsy. His subsequent course was stormy, with evidence of disseminated hematogenous tuberculosis. In 1949, roentgenograms of the dorsal spine revealed an extensive paravertebral abscess (Fig. 4*b*), extending from the level of the 5th to the 12th dorsal vertebrae. Figure 4*c* reveals the cystic zones of destruction, bordered by areas of increased density involving the 10th dorsal body. Lysis of the lower anterior margin of the 9th dorsal and of the centrum of the 8th dorsal are likewise noted. The findings shown in the 10th dorsal segment are more representative of the cystic tuberculous lesions seen in infants and children.

A large well defined lytic zone in the left sacroiliac joint was subsequently discovered as were extensive changes in the entire lumbar spine, study of which will be made subsequently.

Geographic Defect Involving Adjacent Vertebrae

Case 5. A twenty-five year old white male was admitted for pain in the lower back. A roentgen investigation of the lumbar spine disclosed an extensive lytic lesion involving the

TABLE III

ANALYSIS OF LUMBAR SPINE LESIONS

No.	Race	Level	Type	Drainage or Abscess	Other Axial	Assoc. Skeletal	Assoc. Systemic	Proof	Sputum Urine
1	W	L1–2	L	Yes	D8–12		Laryngeal tbc.		
2	N	L3–4	L			4th rib rt., rt. sacroil.	Bilat. testes		
3	W	L3–4	L			Lt. hip		+biopsy	
4	Chin.	L5	L	Yes					
5	W	L1–2	L	Yes			Pl. effus. rt. base		
6	N	L4–5	L	Yes				+smear	
7	N	L1–3	M	Yes	Mult. dorsal				
8	Chin.	L1	L						
9	N	L3–5					Bilat. pl. eff. peritonitis		
10	W	L2–3	M	Yes	C-2		Liver, spl. involved		
11	N	L2–3		Yes					
12	N	L4	M					Cerebral tuberculoma	
13	N	All L	M			Sacroil., lt.	Bilat. bas. inf.	Cerebral tuberculoma	
14	W	L2–3	M						
15	W	L3–5	M						
16	W	L2–3	B		Rt. sacroil.		Rt. renal tbc.		
17	W	L4	L				Rt. pleu. effusion		
18	N	L3–4	L			Lt. elbow resected; rt. sacroil.	Widespr. pulm. dis.		+
19	N	L2–4	L						
20	N	L4–5	L		Rt. sacroil.				
21	W	L1–2, L5	L						
22	N	L3, L5	B				Rt. para T node, cerv. n. biopsy		
23	N	L5–S1	L						
24	N	L1–2	L	Yes				+biopsy	
25	N	L3	L		C5–6	Lt. wrist	+cult. lt. wrist		
26	N	L4–5, S1	B	Yes					

posterior halves of the 1st and 2nd lumbar vertebrae (Fig. 5*a*). The periphery of the lesion appears scalloped and eburnated. The corresponding intervetebral disc space is slightly narrowed. No other changes are identified. Biopsy by means of needle aspiration of the involved segments disclosed no organisms. The possibility of developmental lesion such as a cystic chordoma or notochordal rest was considered, but the patient left the hospital without a diagnosis. He returned six months later, with collapse of the intervertebral disc space L5-S1 and

cystic areas of destruction observed in the body of L5 (Fig. 5*b*). An erosive destructive lesion involving the lower anterior aspect of L4 is also evident. A large inguinal collection was aspirated at this time and a positive culture for tuberculosis was reported.

Progressive Destruction of Vertebra with Preservation of Intervertebral Disc Space, Simulating Neoplastic or Lymphoblastomatous Disease

Case 6. In the fourth year of illness, characterized by masses in the cervical region, generalized weakness and subsequent severe pain in the back, this thirty-one year old white male patient was studied by biopsy of a neck node and a diagnosis of tuberculous disease with caseation necrosis was made in a University Hospital. No growth of the organism was obtained, despite innumerable efforts. Roentgen studies of the dorsal spine revealed a lytic lesion of the 10th dorsal vertebra, which was strikingly wedged (Fig. 6*a*). The intervertebral space, however, was noted as normal. Biopsy of this vertebra was reported as tuberculosis, and spinal fusion was performed. Later the patient developed numbness of both legs and re-study demonstrated a lytic lesion involving the right side of D12 (Fig. 6*b*), as well as virtual disappearance of the 10th dorsal vertebra (Fig. 6*b* and 6*c*). He was admitted to this hospital, where a tentative diagnosis of lymphoblastoma was made but discarded in view of a second biopsy of the diseased vertebra, which was reported by Dr. Henry Jaffe of The Hospital for Bone and Joint Diseases as "showing every feature of tuberculosis, without caseation." Accordingly, the patient's spine was again fused and he was started on streptomycin. He has since had a striking response to the therapy instituted. For these reasons, this case is considered as tuberculous in character.

Before leaving the category of destructive lesions of the vertebral bodies, mention should be made of that type of osseous lesion resulting from vascular pulsation transmitted to the anterior aspects of the centra, through the medium of an extensive overlying paravertebral abscess. Many contiguous vertebrae may be involved, or implicated structures may be separated by bodies which appear to be normal.

Aneurysmal Defects of Anterior Portions of Vertebrae

Case 7. This twenty-nine year old white male was found to have erosive lesions of the 10th and 11th dorsal as well as the 1st and 2nd lumbar vertebrae. A draining paraspinal abscess yielded growth of tubercle bacilli. Figure 7 demonstrates the scalloped defects in the anterior aspects of the involved vertebrae, together with irregular narrowing of several of the intervertebral disc spaces. Cystic zones are also evident in the inferior segment of L2 as well as in the anterosuperior aspect of L4.

Case 8. After a long period of hospitalization and treatment elsewhere for bronchogenic carcinoma, because of the presence of a right mediastinal mass, this twenty-two year old Negro male was admitted to the hospital where an extensive paraspinal abscess due to destructive lesions of D9 and D10 was found. He subsequently developed involvement of C5 and C6, the left scaroiliac joint, and the carpal bones of the left hand from which area draining material was found to contain tubercle bacilli. Figure 8 shows the telescoping lesion of D9 and D10 as well as the characteristic scalloping of the upper dorsal segments.

Case—(previously described under Case 4). This roentgenogram (Fig. 9) of the dorsal spine of the patient whose history has been given previously, graphically illustrates the marked degree of anterior erosion of more distantly located centra which may be encountered. The cystic changes referred to previously in the lower dorsal spine are faintly reproduced here.

A feature in the evolution of osseous tuberculous disease which deserves attention is the speed with which extension of the disease may occur, contrary to the classical thought. It is true that the marked extension of disease may well have existed prior to its roentgen demonstration, but it is nevertheless of interest to demonstrate the changes which may occur with dramatic speed. Scant reference to the occurrence of such changes in osseous tuberculosis exists in the current literature.

The changes in Case 5 are representative of this rapid evolution. Figure 5*a* shows no apparent disease in the lower lumbar spine. Six months later there occurred extensive cytsic changes in the centrum of L5, collapse of the disc space between L5-S1 and erosion of the anterior margin of L4 (Fig. 5*b*).

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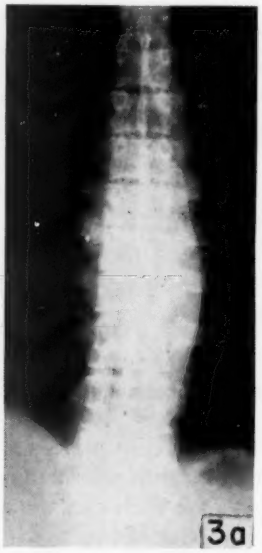
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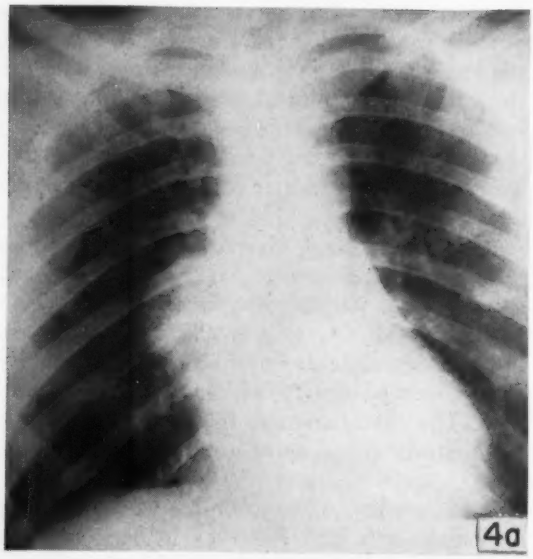
3b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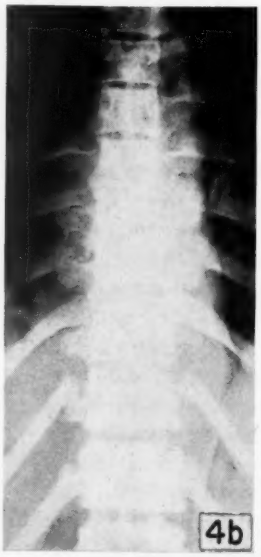
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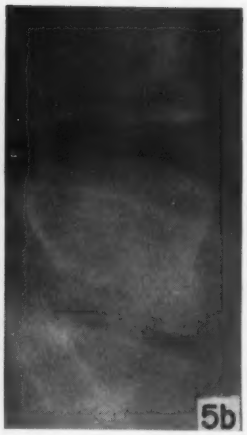
5a


5b

6a

6b

6c

Rapid Evolution of Osseous Changes in Tuberculosis

Case 9. This thirty-five year old white male, was treated in a local hospital for pain in the back. Diagnoses of renal calculus and rheumatoid arthritis were successively entertained. At that time, however, close scrutiny of the studies of the lumbar spine showed no abnormality.

Two months later patient was admitted to this hospital, where a distinctive type of moth-eaten appearance of the apposing osseous surfaces of L3 and L4 were noted (Fig. 10*b*). The anteroposterior view (Fig. 10*a*) reveals "kissing" defects of the left lateral aspect of the corresponding surfaces of L3-L4. The patient was treated conservatively, but after three months, re-examination of the lumbar spine indicated massive progress of disease (Fig. 10*c*) with participation of all of the lumbar vertebrae and disc spaces. The only additional feature of interest was the presence of a pulmonary infiltrate and a positive tuberculin reaction. For these reasons, despite the inability to secure bacteriologic proof, this patient was considered to have tuberculosis and was so managed by successive spinal fusions and streptomycin. His response to therapy was excellent.

2. *Productive, Blastic or Eburnative Lesions of the Dorsal and Lumbar Spine*

Increase in bone density in tuberculous spine lesions was initially described by Cleveland and Bosworth[4] and subsequently re-examined by Bosworth.[3] These authors stressed the extensive obliterative endarteritis which is a striking pathological feature of tuberculosis of the spine, and which results in a marked impairment of the blood supply to the involved structure. This vascular compromise induces a very frequently observed reaction, namely, calcification, in addition to a phenomenon not heretofore associated with tuberculosis, bone "sclerosis" or production. They indicated that the intermingling of the destructive process inherent in tuberculous disease of bone and the reactive process stimulated by vascular occlusion may balance each other so effectively as to prevent roentgen detection of even extensive bone damage. Finally, these workers postulated that excessive endarteritis might cause predominantly productive changes, and Bosworth

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Fig. 1. Case 1. *Lytic Tuberculous Diseases of Cervical Spine.* The marked degree of destruction and collapse of C3 and C4, as well as of the intervening disc are readily apparent. The prevertebral soft tissue is minimally thickened.

Fig. 2. Case 2. *Circumscribed Lytic Lesion Occurring as a Unifocal Osseous Manifestation.* A circumscribed zone of radiolucency is seen in the inferior aspect of the centrum of D11. There is a slight degree of narrowing of the disc space below the involved vertebra.

Fig. 3*a*. Case 3. *Circumscribed Lytic Lesion Occurring in the Presence of Known Osseous Tuberculosis at a More Remote Level.* A well defined paravertebral soft tissue density is noted to the left of the lower dorsal spine, extending from D8 to D12. The disc space between D8 and D9 is narrowed. Fig. 3*b*. A rounded area of destruction is seen in the inferior aspect of the body of L1. Definite narrowing of the subjacent disc space is present, as well as eburnation and mild reactive hypertrophic changes about the apposing osseous surfaces.

Fig. 4*a*. Case 4. *Multiple Circumscribed (Cystic) Lesions of Vertebrae.* Roentgen study of the thorax reveals a large right hilar nodal density. Fig. 4*b*. An extensive left paravertebral abscess extends from the level of D5 to D12. Fig. 4*c*. Multiple, clearly marginated zones of destruction are visualized in the centrum of D10. There is irregular destruction of the anterior border of D9.

Fig. 5*a*. Case 5. *Geographic Defect Involving Adjacent Vertebrae.* A huge lesion hollows out the posterior halves of L1 and L2. Minimal narrowing of the corresponding disc space is seen. No other changes are visualized. Fig. 5*a*. Rounded lytic lesions are now apparent in the body of L5 and there is irregular destruction of the interspace between L5-S1. An erosive lesion is also observed at the inferior aspect of the anterior border of L4, not present in earlier study.

Fig. 6*a*. Case 6. *Progressive Destruction of Vertebra with Preservation of Intervertebral Disc Space, Simulating Neoplastic or Lymphoblastomatous Disease.* There is marked loss of vertical height of D10 resulting in a striking degree of anterior wedging. The intervertebral disc spaces at this level are normal. Fig. 6*b*. Follow-up study of the dorsolumbar spine now indicates the existence of a lytic lesion of the right half of D12. D10 has virtually disappeared. Note the crowding of the 9th and 10th ribs, bilaterally. Fig. 6*c*. The lateral study confirms the utter disappearance of D10 and the essential preservation of the disc spaces above and below the involved centrum. Kyphosis of the spine is held to a minimum for this reason.

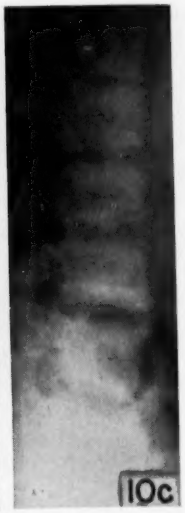
7

8

9

10a

10b


10c

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14a

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more recently stated that the productive changes might be so intense as to simulate hypertrophic spondylitis and a differential diagnosis therefrom rendered extremely difficult. Moreover, in the presence of abscess formation, resulting in stripping of a variable segment of the ligamentous structures and attached vascular elements from the anterior aspect of the involved spine, whole centra may suddenly undergo bone death, without manifesting any roentgen evidence of change, in view of the preservation of the specific gravity of the compromised structures.

Auerbach and Stemmerman[2] subsequently demonstrated histopathologically the presence of frank productive changes in autopsy specimens of diseased vertebrae which showed extensive increase in density, roentgenographically. These investigators described such lesion, macroscopically, as grossly yellow in appearance and firm throughout. Microscopically, they noted the presence of tuberculous granulation tissue proliferating in the marrow spaces of these dense vertebrae. Auerbach and Stemmerman concluded, however, that although such productive lesions unquestionably occurred pathologically, the possibility of their roentgen recognition was remote.

Since the publication just mentioned,

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Fig. 7. Case 7. *Aneurysmal Defects of Anterior Portions of Vertebrae.* Scalloped indentations of L1, L2 and L3 are present, as well as diminution of several of the visualized intervertebral disc spaces. The anterior erosive defects cease abruptly at the level of reactive hypertrophic changes which resist the trauma of transmitted pulsations. Lytic lesions of L2 and L4 are evident.

Fig. 8. In addition to the readily apparent defects in the anterior aspects of the upper dorsal segments, there is also observed advanced involvement of D9 and D10, source of the paravertebral abscess.

Fig. 9. Case—(previously described under Case 4). The lower segment of this dorsal spine was reproduced earlier (see Fig. 4*c*). The deep anterior notchings of the mid-dorsal bodies located at an appreciable distance from the seat of the abscess are unusually well delineated.

Fig. 10*a*. Case 9. *Rapid Evolution of Osseous Change in Tuberculosis.* There is irregular diminution of the intervertebral disc space between L3 and L4. "Kissing" defects of the apposing osseous aspects of the left side of the involved vertebrae are shown. Roentgenograms taken two months earlier *were normal.* Fig. 10*b*. The ragged appearance of L3 and L4 is striking. Note that there is complete preservation of the disc space between L4 and L5. The latter vertebra is well identified and is normal in appearance. Fig. 10*c*. There has occurred rapid extension of disease in a two month interval with profound alteration of all of the component parts of the entire lumbar spine.

Fig. 11. Case 10. *Localized Juxta-peripheral Blastic Changes.* Although there is evident destructive disease of the disc space between L1 and L2, the increase in bone density of the involved centra, particularly that of L1, is more striking.

Case—(previously described under Case 4). *Extensive Productive Changes Simulating Osteosclerosis.* Previous figures (4*a*, 4*b*, 4*c*, and 4*d*) depicting the cystic lesions of the dorsal spine, as well as the aneurysmal defects of the anterior aspects of these vertebrae have been documented.

Fig. 12. This reveals the universal increase in density of all of the lumbar bodies. Discrete areas of bone breakdown are interspersed amid the involved centra, principally at the inferior aspect of the anterior portion of L4. Of special interest is the complete absence of disc involvement or other classical stigmata of osseous tuberculosis.

Fig. 13. Case—(previously described under Case 10). *Mixed Lesions of the Dorsolumbar spine.* This follow-up roentgenogram of the lumbar spine now reveals an increase in both the blastic and lytic elements of the diseased centra illustrated in Figure 11. Note the frank productive changes observed at the anterior aspect of the lesion. Minimal reactive changes are also present at the anterosuperior margin of L1.

Fig. 14*a*. Case 11. *Proliferative Lesions of Vertebral Bodies.* The striking increase in bone density of L2 and L3 is evident, as are the distortion in internal architecture and rotation laterally of the right kidney, due to a large psoas abscess. The fine proliferations about the involved centra are likewise shown. Fig. 14*b*. Follow-up study after 14 months therapy shows slight but definite increase in reactive changes about the left lateral aspect of L3. There has occurred complete restoration of the appearance and location of the right kidney.

Fig. 15. Case 12. *Lacelike Luxuriant Ligamentous Ossification.* This study taken from a urinary investigation shows the luxuriant, lacelike deposit of bone along the right lateral aspect of the lumbar spine. Irregularly erosive lesions of the right lateral portions of L2 and L3 are also demonstrated.

only an occasional reference to roentgen changes of this kind, in vivo, has appeared in the literature.[6] In our series, a significant number of cases exhibited striking degrees of productive, eburnative or blastic changes. These lesions usually involved the centra, and varied in degree from small discrete juxtaperipheral zones to massive alteration of one or more bodies or an entire segment of spine.

Localized Juxtaperipheral Blastic Changes

CASE 10. A diagnosis of right renal tuberculosis, with calcification, was made in this case of a thirty-six year old white male. Two years later, an extensive active pulmonary tuberculosis with positive sputum was discovered and the patient was treated by bed rest. In February, 1946, the lumbar spine was roentgenographed because of persistent pain. Figure 11 demonstrates a destructive process involving the disc space between L1 and L2, together with a prominent increase in bone density of the lower half of the centrum of the first lumbar vertebra.

Extensive Productive Changes Simulating Myelosclerosis

Case—(previously described under Case 4). The roentgen examination of the lumbar spine (Fig. 12) reveals a striking spotty increase in bone density of all of the centra of this segment of the spine. There are, however, discrete areas of frank erosion, best observed along the inferior aspect of the anterior margin of L4.

The latter roentgenogram assuredly invites consideration of other diagnostic possibilities and is essentially indistinguishable roentgenographically from studies obtained in osteoblastic metastatic disease, osteosclerosis, and in our own experience, from lymphomatous disease.

3. *Mixed Lesions of the Dorsolumbar Spine*

This type of involvement is frequently noted and, in the strictest sense, the preceding examples differ from this category only in that the productive or eburnative element was signally prominent. Indeed, many cases of essentially increased bone density later show a more destructive component.

Mixed Lesions of the Spine

Case—(previously described under Case 10). Following the discovery of the lumbar spine disease noted in Figure 11, this patient refused operation and left the hospital, only to return one month later with increasing pain and disability. Figure 13 discloses an increase in bone pathology with unmistakable osseous proliferation, noted about the anterior margins of the vertebrae, in addition to increasing destruction of the disc space. There is again noted the increase in bone density of the lower portion of L1. The rapid change in roentgen appearance is of interest.

4. *Proliferative Lesions of the Dorsolumbar Spine*

This rarely demonstrated manifestation of tuberculous spondylitis consists of either true bony proliferation stemming from the body of the vertebra, or paraspinal calcification and/or ossification obviously due to disease extending along these structures which serve as a confining mold or scaffolding for the caseous material. An example of the former type of involvement is incidentally included in the illustration presented above (Fig. 13).

Proliferative Lesions of Vertebral Bodies

CASE 11. This twenty-six year old white male was admitted to this hospital with a diagnosis of Hodgkin's disease of the lumbar spine because of dense bony changes involving L2 and L3. During the course of roentgen investigation, an intravenous pyelogram (Fig. 14*a*) demonstrated a considerable increase in density of L2 and L3, with irregular diminution of the corresponding interspace, fine, shaggy proliferations about the margins of the vertebral bodies involved, and the presence of a large right psoas muscle abscess, resulting in elevation and lateral displacement of the right kidney, which presented moderate caliectasia due to impingement upon the ureteropelvic junction. Although no bacteriologic proof was obtained, this case was presumed to be tuberculous on the basis of significant clinical findings (sedimentation rate, psoas abscess and response to streptomycin). Figure 14*b* is a follow up study of the lumbar spine done fourteen months later, and reveals minimal increase in bony proliferation, noted best about the left inferior border of L3. There is

marked improvement of the previously noted psoas abscess. Intravenous urogram at this time demonstrates complete restoration of the position and size of the right kidney.

The paraspinal or ligamentous changes are represented by irregular, lacelike, and frequently luxuriant calcification and/or ossification. Occasionally, this type of ligamentous deposit is frankly bony and its appearance is essentially indistinguishable from the bridging, beaking and spurring seen in advanced hypertrophic spondylitis.

Lacelike Luxuriant Ligamentous Ossification

Case 12. Because of a four to six month history of weight loss, and enlarged liver and spleen, as well as lytic lesions of several of the lumbar vertebrae, a laparotomy was performed on this forty-four year old white male in a local hospital. Due to the appearance of the liver, a biopsy of this organ was taken. A psoas muscle abscess found on operation was likewise cultured. Histopathological diagnosis from both sources was tuberculosis. Subsequently, a cervical spine lesion occurred.

Figure 15 shows the irregular lacelike ossification which parallels the right side of the lumbar spine, as well as the irregular bony changes of the centra of the corresponding vertebrae.

Ossification of the Anterior and Paraspinal Ligaments

Case 13. This twenty-eight year old Negro male patient developed an infiltrate in his lung in 1945. His sputum was positive. In 1947, he developed multiple fluctuant areas in the right knee, left elbow and over the anterior chest wall. Culture of draining material from the chest wall was positive for tuberculosis. Study of the lumbar spine in April, 1948 (Fig. 16*a*), shows a suggestive increase in density of the 3rd lumbar vertebra. In addition there is noted a prominent spurring and bridging of the adjoining bodies. Figure 16*b*, eight months later, reveals a marked progression in bony density of the upper four lumbar vertebrae along with a striking increase in the extent of the bony deposit in the anterior spinal ligament.

Figure 16*c* is a roentgen study of the thorax dated April, 1948. A radiolucent defect in the superior aspect of the third right anterior rib is shown. Another rib lesion in the left hemithorax is here obscured. This patient ultimately died. in March, 1949, of disseminated hematogenous disease.

Case 14. In 1944, a diagnosis of tuberculous spondylitis of the dorsal spine of this thirty-five year old Negro male was made in an Army hospital because of a destructive lesion involving the 7th dorsal vertebra. He was treated conservatively. Later that year, an increase in density of L2 was noted (Fig. 17*a*). In addition, faint but definite anterior calcification along L2 as well as L3 was observed.

In April, 1946, an extensive dorsolumbar fusion was undertaken because of the lack of response to bed rest. A postfusion lumbar study (Fig. 17*b*) shows increase in productive changes of L2, as well as L1 and L3, in addition to ossification of the anterior spinal ligament. Figure 17*c* is an anteroposterior lumbar study, postfusion, to exemplify both the prominent ossification of the paravertebral ligaments at the level of the right side of L2-L3, and the smooth, bamboo-like calcifications at the left side of this same interspace as well as on the right side of the intervertebral space below. This patient ultimately developed clinical evidence of tuberculous involvement of the epididymes as well as the prostate.

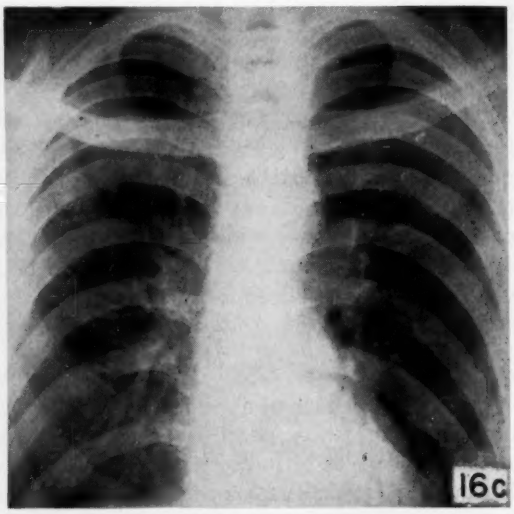
5. Statistical Analysis of Dorsal and Lumbar Spine

(a) *Dorsal Spine* (Table 11). Thirty-six cases involving chiefly the lower dorsal spine were studied. There were 25 white patients, 9 Negroes and 2 Puerto Ricans in this group, of which 11 were proved conclusively, 10 manifested strongly presumptive evidence of tuberculosis and the remainder were clinically so diagnosed. Of this entire group, 27 cases showed extensive lytic or destructive lesions with varying degrees of disc destruction. Of the remaining 8 cases, 6 showed predominantly blastic or eburnative lesions and 2 showed mixed lesions. Five cases presented proliferative disease resulting in the marked ligamentous calcification and/or ossification discussed above.

(b) *Lumbar Spine* (Table 111). The lumbar spine showed involvement in 26 instances with L2, L3 and L5 presenting the most frequent sites of disease. In this group there were 9 white patients, 15 Negroes and 2 Chinese. Conclusive proof of tuberculous spondylitis was obtained in 7

16a

16b


16c

17a

17b

17c

18a

18b

19

cases, strongly presumptive evidence in 7 instances while in the remaining 12 cases the diagnosis was accepted on the basis of clinical and roentgenological evidence. Of this entire group 16 presented lesions that were predominantly lytic, 5 were blastic or eburnative, and 5 were mixed. Proliferative changes were noted in 4 cases.

(c) *Tuberculosis of the Bones of the Pelvis.* With the exception of 2 instances of isolated involvement of the ilia, tuberculosis of the pelvic girdle is overwhelmingly limited to the sacroiliac synchondrosis. We have encountered 24 cases of this type (Table IV). Twelve patients were white, 9 Negro, 2 Puerto Rican and 1 Japanese. In this entire series, conclusive proof was established in 5 cases, strongly presumptive evidence in 13 instances, while in 6 patients the diagnosis was made clinically. There was bilateral involvement in 3 cases. The remaining 21 cases showed disease on the right side in 12 instances, and on the left side in 9. In 15 cases, the entire joint was involved. In 4 cases, the mid third was predominantly involved. In 2 cases, the upper third was implicated, and in 3 cases the lower aspect of the joint was the site of the disease.

The type of involvement is divided into three groups, namely lytic, blastic and mixed. We found 14 instances of lytic involvement, 2 blastic or eburnative and 10 mixed.

Hitherto, little stress has been placed on sacroiliac tuberculosis insofar as its roentgen appearance is concerned. It is especially important to emphasize the unquestioned frequency of combined lytic and eburnative lesions of the sacroiliac joints. In our experience sacroiliac tuberculosis has frequently been misinterpreted as rheumatoid arthritis, nonspecific inflammatory or suppurative arthritis and finally neoplastic, *i.e.*, Hodgkin's disease. The unilaterality of the disease is of great differential importance.

The most frequent lesion—the lytic—may appear first as an irregular, ragged widening of the joint space with varying degrees of subchondral deossification. Next in order of occurrence is the appearance of a focal lytic zone which varies in size and may involve any area of the entire joint. Predominantly blastic lesions are especially important, since tuberculosis is not usually incriminated as an etiologic agent. Although it has been claimed that tuberculosis most

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FIG. 16*a*. Case 13. *Ossification of the Anterior and Paraspinal Ligaments.* This demonstrates a slight increase in the density of L3 of this twenty-eight-year old Negro patient. The marked reactive calcific changes resulting in spurring and bridging with the adjacent centra are evident. Fig. 16*b*. This roentgenogram eight months later discloses a remarkable increase in density of the upper four lumbar vertebrae as well as frank ossification of the previously described spurring and bridging. The absence of other classical stigmata of bone tuberculosis is again worthy of mention. Fig. 16*c*. A chest roentgenogram to demonstrate a "silent" lytic lesion of the 3rd right anterior rib, along its superior border. Another rib lesion in the left hemithorax is not shown. Patient died of disseminated hematogenous tuberculosis one year later.

FIG. 17*a*. Case 14. The increase in bone density of L2, as well as of L3, is shown here, along with minimal ligamentous changes anteriorly. Discrete narrowing of the intervertebral disc space is present. FIG. 17*b*. A two year follow-up study reveals the pronounced increase in density of the previously described centra. In addition there is now present ossification of the anterior ligaments. FIG. 17*c*. This film, selected from a urographic study, depicts the post-fusion status as well as the prominent ossification of the paravertebral ligaments at the level of the right side of L2, L3. In addition the smooth, bamboo-like calcifications buttressing the left lateral aspect of the lumbar spine at this level, as well as the intervertebral space below, are well shown.

FIG. 18*a*. Case 15. *Discrete Focal Destructive Changes of Sacroiliac Region.* This film reveals the presence of pericardial and left pleural effusions. Fig. 18*b*. Demonstrates a lytic zone in the mesial aspect of the wing of the left ilium. Incidental to the examination, there is noted a pseudarthrosis between a transitional, left 5th transverse process and the corresponding sacral segment with focal reactive changes.

FIG. 19. Case—(previously described under Case 4). *Discrete Cystic Lesion with Sclerotic Reaction.* Film of the pelvis of the patient, whose extensive spine changes have been previously reproduced (Fig. 4*a*, 4*b*, 4*c*, 9 and 12). A well defined lytic zone, with a moderately intense delimiting zone of increased density is seen in the mid-portion of the left sacroiliac joint.

TABLE IV

SACROILIAC

No.	Race	Type	Assoc. Skeletal	Assoc. Systemic	Site	Side	Proof	Sputum Urine
1	P.R.	M	D8–9, L4–5	Apical infilt.	Entire	Bilat.		
2	N	L	D12–L1, C2, rt. wrist	Rt. epididymectomy	Entire	Rt.		
3	N	L	L3–4, 4th rt. rib	Bilat. orchidectomy	Entire	Unilat.		
4	N	B			Lower third	Rt.	+biopsy	
5	W	L			Entire	Rt.	+biopsy	
6	W	M		Rt. testicle, rt. kidney	Middle third	Bilat.		+
7	N	L			Upper third	Lt.	+biopsy	
8	N	M	9th lt. rib	Lt. pl. eff. pericard. eff.	Upper half	Lt.	Perit. biop.+	
9	W	M	Rt. 6th rib	Rt. pulm. dis., Renal tbc.	Entire	Rt.		+
10	W	L			Entire	Lt.		
11	W	L			Lower half	Rt.		
12	W	M	L2–3		Entire	Lt.		
13	N	L	D11–12, L1		Entire	Rt.	+cult.	
14	N	L		Tbc. meningitis	Entire	Rt.	+sp. fluid	
15	W	M	L2–3		Entire	Rt.		
16	W	B	Lt. elbow resected	Lt. nephrectomy	Entire	Rt.		+
17	W	L	D-9	Renal tbc.	Entire	Rt.	+sm. dors. area	+
18	N	L			Entire	Rt.		
19	W	L	Lt. hip		Entire	Lt.		
20	Jap.	M		G.U. (kidney, testes, epidid. prostate)	Middle third	Rt.		+
21	P.R.	M			Entire	Rt.		+
22	W	M			Middle thirds	Bilat.		+
23	W	L			Entire	Lt.		
24	N	M	Rib, ent. spine	Tuberculoma of brain removed	Middle	Lt.		

frequently attacks the inferior aspects of the sacroiliac joints,[7] our findings indicate that, in a significant number of instances, any segment of the articulation may be attacked. A favored site for small cystic lesions is the mid-portion of the joint.

Discrete, Focal, Destructive Changes of Sacroiliac Region

CASE 15. A twenty-three year old colored male was originally treated for a pericardial effusion, presumed to be tuberculous. A laparotomy for acute abdominal pain was later performed and a mesenteric node was removed. Histopathology showed a single noncaseous tubercle suggestive of tuberculosis. The patient thereafter developed a left pleural effusion (Fig. 18*a*) and pain in the left buttock. Roentgen study of the pelvis showed a discrete lytic zone, in the left sacroiliac region. Eventually a similar lesion appeared in the ninth right posterior rib (Fig. 26*a*).

Discrete Cystic Lesion with Sclerotic Reaction

Case—(previously described under Case 4). The pelvis (Fig. 19) is that of a previously described patient presenting a right hilar node, a left cerebral tuberculoma and extensive changes

of the entire dorsolumbar spine. A well defined cystic lesion with a dense marginal area is evident in the mid-portion of the left sacroiliac joint.

Lytic Sacroiliac Tuberculosis

Case 16. This colored male in his early twenties complained of pain in his lower back in 1949, and a survey roentgenogram of the lumbosacral junction revealed normal structures (Fig. 20*a*). One year later, in August, 1950, patient returned with a large fluctuant abscess in his left buttock. Repeat studies revealed a definite widening of the right sacroiliac joint (Fig. 20*b*), with clouded osseous margins. In addition, there is noted a preponderant demineralization of the osseous structures of the right side of the pelvis and right hip. Aspiration of the abscess was positive for tuberculosis. The patient later developed a tuberculous meningitis, which is being successfully managed with drug therapy, as well as proved involvement of the urinary tract.

Lytic Sacroiliac Disease Occurring Concomitantly with Predominantly Eburnative Involvement of L4–L5, Sacrum and Left Knee

Case 17. This patient was a twenty-two year old Puerto Rican male who complained of pain in the low back over a period of fifteen months. Study on admission disclosed a bilateral apical infiltration, in addition to marked productive changes involving L4 and L5, as well as the first sacral segment. Scalloped erosive areas of the corresponding apposing osseous surfaces were evident (Fig. 21*a*). Prominent cystic changes together with frankly productive peripheral zones involving especially the superior pole of the right sacroiliac joint are likewise observed on the latter roentgenogram. Parallel studies of the dorsal spine disclosed destruction of the intervertebral disc space between D8 and D9, and a discrete paravertebral abscess to the left of the involved vertebral segment (Fig. 21*b*). The left knee showed roentgen changes highly suggestive of tuberculosis.

The patient left the hospital before further investigation was possible.

Bilateral Cystic Lesions of Sacroiliac Joint

Case 18. Originally treated with artificial pneumothorax for extensive tuberculous disease cavitary of the right lung, with positive sputum, this twenty-two year old white male developed severe pain in the low back two years later. Examination of the sacroiliac joints (Fig. 22*a* and 22*b*) shows bilateral lytic lesions, with faint definite marginal eburnation noted bilaterally. Bilateral sacroiliac fusion was undertaken with good results.

Mixed Lesions of the Sacroiliac Joint

Case 19. In 1937, this forty-six year old white male was studied for a right renal calculus with slight hydronephrosis. The sacroiliac joints and lumbar spine (Fig. 23*a* and 23*b*) appeared normal. He returned six years later with pain in his back of several months' duration. Figure 23*c* discloses intense productive and lytic lesions involving the right sacroiliac joint. Concomitantly, there is marked productive disease involving L2 and to a lesser degree L3 with proliferative changes affecting the anterior aspects of these structures (Fig. 23*d* and 23*e*). There is a mild degree of narrowing of the corsponding intervertebral joint space. Because of the unilateral sacroiliac disease and the focal lumbar changes, as well as the location of this spinal disease, a diagnosis of tuberculosis was made. Fusion was contemplated but the patient left the hospital.

Predominantly Blastic Lesions of Sacroiliac Joint

Case 20. A young white male in his middle twenties had been treated for proved tuberculosis of the urinary tract. During the course of his treatment, the patient developed persistent pain in the right sacroiliac joint. Examination of the pelvis (Fig. 24) showed an increase in bone density of the iliac portion of the right sacroiliac joint, which is striking when compared to the relatively normal left sacroiliac joint. Discrete but cystic changes are likewise present. Fusion of the synchondrosis was performed. Unfortunately, a biopsy specimen was lost.

Case 21. After innumerable episodes of proved genitourinary tuberculosis resulting in resection of the left kidney and right testis, this thirty-one year old Japanese-American was found to have a lesion in his right sacroiliac joint. Figure 25 reveals the predominantly blastic changes involving the mid-section of the right sacroiliac joint.

20a

20b

21a

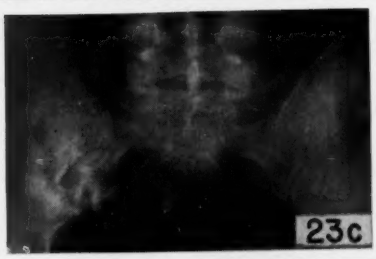
21b

R
22a

L
22b

23a

23b


23c

23d

23e

24

25

II. RIB TUBERCULOSIS

We have collected 13 cases of rib tuberculosis (Table v). The lesions were too scattered to permit any statement as to a site of predilection. In this group there were 4 white persons, 8 Negroes and 1 Puerto Rican. In 6 cases the diagnosis was conclusively established while in the remaining 7 instances the diagnosis was considered strongly presumptive. The lesions were predominantly lytic (11 cases) while in 2 there was evidence of mixed lytic and eburnative lesions. No purely blastic lesions were encountered.

As a rule, lesions of the ribs are extremely small and discrete and may easily be overlooked. They are usually unifocal in any one rib although we have encountered multiloculated areas of lytic defects surrounded by zones of eburnative involvement in 2 instances. It should also be emphasized that multiple rib involvement is not infrequent (5 cases) and that the ribs involved may be rather widely separated. Large destructive lesions indistinguishable from metastatic neoplastic disease or even primary bone tumors with pathological fractures are also encountered.

Although it has been stated by Nathanson and Cohen[10] that rib lesions are usually secondary to and associated with contiguous vertebral involvement, our series of 13 cases affirms Auerbach's[1] view that these structures are frequently involved without related tuberculous spondylitis. The latter author cited the figure of 30 per cent of tuberculous rib involvement occurring in the absence of known vertebral disease. Our analysis discloses the rather impressive fact that in 6 out of 13 cases there was no demonstrable vertebral involvement. In 5 cases there was vertebral involvement far removed from the site of the rib lesions and in only 2 cases was there adjacent tuberculous spondylitis.

It should also be noted that in 7 out of the 13 cases there was no evidence of significant pleural and/or parenchymal disease, with the remaining 6 cases showing some significant involvement in the lungs and/or pleura. In these 6 cases there were 3 in whom the pleural or parenchymal dis-

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FIG. 20*a*. Case 16. *Lytic Sacroiliac Tuberculosis.* Normal roentgen study of pelvis of a young colored male complaining of pain in back. FIG. 21*a*. One year later, the patient returned with a large fluctuant abscess in his left buttock. The follow-up roentgenogram of the pelvis (FIG. 21*b*) reveals an irregularly widened, and clouded right sacroiliac joint. Marked unilateral deossification of the right side of the pelvis is apparent. Aspiration of abscess proved positive for tuberculosis.

FIG. 22*a*. Case 17. *Lytic Sacroiliac Disease Occurring Concomitantly with Predominantly Eburnative Involvement of L4–L5, Sacrum and Left Knee.* This pelvis of a twenty-two year old Puerto Rican male who complained of low back pain for fifteen months is the seat of lytic lesions involving the superior pole of the right sacroiliac joint, predominantly. Concomitant blastic changes of L4 and L5 are present, as well as of the first sacral segment. Irregular destruction of the intervening disc spaces are observed. Fig. 22*b*. Indicates the existence of a paravertebral abscess involving the left side of the lower dorsal spine with narrowing of the space between D8 and D9.

FIG. 22*a* and 22*b*. Case 18. *Bilateral Cystic Lesions of Sacroiliac Joints.* Oblique views of the sacroiliac joints of a twenty-two year old white male with known pulmonary tuberculosis and pain in the low back region. Prominent cystic lesions, bordered by faintly demarcated areas of increased bone density are noted at the mid-plane of each joint.

FIG. 23*a* and 23*b*. Case 19. *Mixed Lesions of the Sacroiliac Joints.* Normal studies of the upper lumbar segment and sacroiliac joints of a forty-six year old male who was examined for a renal calculus. Six years later, patient returned because of pain in the back and re-examination (FIG. 23*c* and 23*d*) now show marked cystic and blastic lesions involving the right sacroiliac joint. The proximal lumbar vertebrae are markedly increased in density, when compared to the earlier normal studies. FIG. 23*e*. Lateral view of the involved lumbar vertebrae, demonstrating increase in bone density, as well as anterior proliferative changes.

FIG. 24. Case 20. *Predominantly Blastic Lesions of Sacroiliac Joint.* Blastic changes involving the lower third of the right sacroiliac joint. The left sacroiliac synchondrosis is normal. This young white male had proved urinary tuberculosis.

FIG. 25. Case 21. This film reveals a predominantly blastic unilateral sacroiliac lesion in a thirty-one year old Japanese with proved genitourinary tuberculosis.

TABLE V

ANALYSIS OF RIB LESIONS

No.	Race	Level	Type	Drainage or Abscess	Assoc. Skeletal	Assoc. Systemic	Proof	Sputum Urine	Site
1	P.R.	5th lt. rib	L	Yes	D3–4–5, C-3	Rt. pleur. effusion	P.M.		Ind.
2	W	Lt. 8th rib	L		Lt. wrist, rt. elbow, lt. foot	Ocular			Ind.
3	N	4th rt. rib	L		Rt. sacroiliac	Bilat. orchidectomy			Ind.
4	W	Lt. low. ant. ribs	L	Yes	D11–12, L1, lt. sacroiliac		+biop.		Contiguous
5	N	9–11 rib, lt.	L	Yes	D6, D12		+drain ch. wall		Ind.
6	N	Rt. 1st rib	L			Rt. ilium	Pulm. inf., rt. pl. eff.		Ind.
7	N	11–12 lt.	L	Yes	D11–12		Mil. pulm., renal tbc.	++	Contiguous
8	N	3rd rt., 7th lt.	L	Yes	All vert. rt. knee, rt. elbow	Diff. pulm.	+drain	+	Ind.
9	W	Rt. 7, Rt. 10	M L	Yes	L1–2–3 lt. ankle	Rt. pleu. density	+biop.		Ind.
10	N	Rt. 8	L			Pulm. inf.	Biopsy		Ind.
11	N	Lt. 9, Rt. 11	L	Yes	Rt. index f., lt. elbow	Rt. orchidect., old pl. eff.			Ind.
12	N	3rd rt. rib	L		All vert.	Cerebral tuberculoma, bilat. basil. infilt.			Ind.
13	W	Rt. 6th rib	L		Rt. sacroiliac	Rt. lung, rt. renal		+	Ind.

ease was not anatomically related to the [illegible]ing of disseminated osseous tuberculosis.) rib lesion. Suffice it to say at this time that in 7 cases of rib involvement we have encountered evidence of widespread hematogenous disease manifested by either multiple disparate osseous lesions, genitourinary tuberculous or obvious pulmonary dissemination.

It is felt, therefore, that in the majority of instances, tuberculous rib lesions occur independently of concomitant vertebral, pleural or parenchymal disease. These data would then suggest a hematogenous origin for most rib lesions which is not surprising in view of the currently accepted pathogenetic concept of osseous tuberculous involvement. The significance of the hematogenous origin of rib lesions is further attested to by the concomitant presence of indisputable hematogenous dissemination to other skeletal structures. (This view will be further amplified below under the head-

Focal Rib Destruction

Case—(previously described under Case 15). The case history in this instance has been previously outlined. Figure 26*a* shows a well defined cystic zone in the 9th posterior rib, not present in earlier studies. Subsequent examination done six months later (Fig. 26*b*) confirms the cystic process but there is seen at this time slight expansion and resulting asymmetry of the rib

structure as well as increase in bone density. Of interest is the complete resolution, following streptomycin therapy, of the pleural and pericardial effusion, originally observed (Fig. 18*a*). The presence of a right paratracheal lymph node is now noted.

Destructive Lesions Simulating Neoplastic Involvement

Case 22. This middle-aged Negro patient was admitted with a diagnosis of bronchogenic carcinoma because of a right parahilar infiltration and a lytic lesion of the 8th right posterior rib, which was surrounded by a soft tissue reaction (Fig. 27). The pulmonary disease proved evanescent, and was consequently considered as an atypical pneumonia. Rib biopsy revealed a granulomatous lesion consistent with tuberculosis.

Case 23. In addition to destructive lesions of the lumbar spine, and left ankle, this twenty-four-year old white patient presented an irregular destructive lesion involving the posterior aspect of the 10th right rib (Fig. 28). Biopsy was positive for tuberculosis. Simultaneous involvement of the 7th right rib is not technically reproducible.

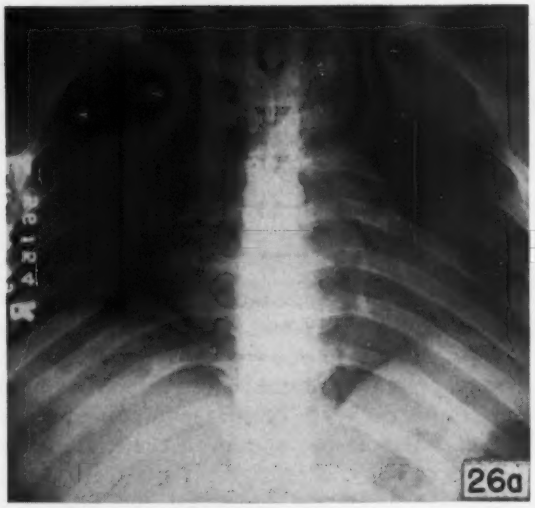
Disseminated Variegated Lesions of Ribs

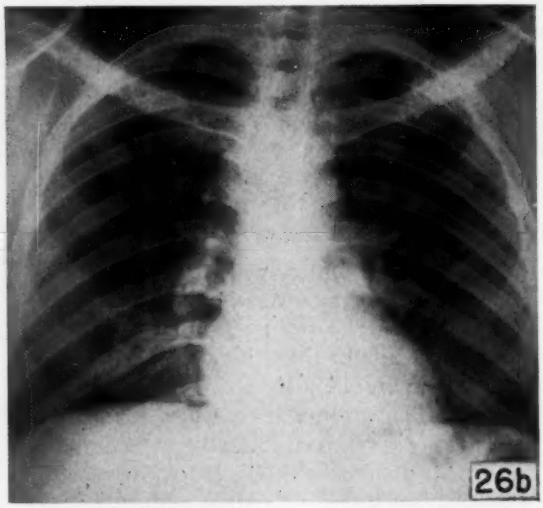
Case 24. After three months of severe pain in the back, following a twist of the spine during a boxing match, this twenty-four-year old Negro patient presented severe temperature rises, and progressive cachexia. Roentgenographic examination of the osseous systems revealed multiple lytic lesions in the skull, right wrist, ribs, and spine. He ultimately developed two large abscesses over the lower spine. These contained

Table VI

RECAPITULATION OF AXIAL SKELETAL LESIONS

Segment	Race	No.	Per Cent	Proof	No.	Per Cent	Character	No.	Per Cent
Cervical Spine 9 cases	W	2	22	Proved	4	44	All lytic		100
	N	6	67	Strongly presumptive	5	56			
	P.R.	1	11	Others	0	0			
	Total	9	100		9	100	Total		100
Dorsal Spine 36 cases	W	25	71	Proved	13	37	Blastic	6	17
	N	9	26	Strongly presumptive	11	31+	Mixed	3	5
	P.R.	2	3	Cl. diag.	11	31+	Lytic	27	78
	Total	36	100		35	100		36	100
Lumbar Spine 26 cases	W	9	33	Proved	7	26	Blastic	5	18
	N	15	59	Strongly presumptive	8	30	Mixed	5	18
	Ch.	2	8	Cl. diag.	11	54	Lytic	16	74
	Total	26	100		26	100		26	100
Sacroiliac Spine 24 cases	W	12	54	Proved	5	21	Blastic	2	8
	N	9	33	Strongly presumptive	13	54	Mixed	10	42
	P.R.	2	9	Cl. diag.	6	25	Lytic	12	50
	J	1	4						
	Total	24	100		24	100		24	100
Ribs 13 cases	W	4	31	Proved	6	46	Blastic	0	0
	N	8	62	Strongly presumptive	7	54	Mixed	2	15
	P.R.	1	7	Cl. diag.	0	0	Lytic	11	85
	Total	13	100		13	100		13	100


26a


26b

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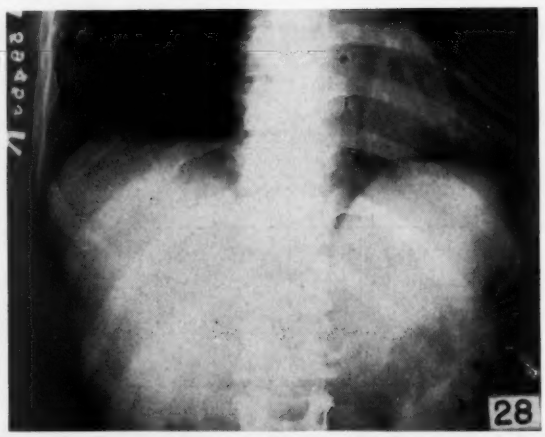

28

29a

29b

caseous material. A draining sinus later appeared over the dorsum of the right wrist, and right buttock. Guinea pig inoculation and culture at this hospital were unsuccessful and the patient died before bacteriologic proof was obtained.

Figure 29*a* shows areas of lysis in the 5th and 7th right ribs anteriorly as well as moth-eaten and ragged areas of destruction of the posterior 4th and 5th right ribs. Scalloping of the inferior border of the 5th right rib posteriorly, as described by Leader,[9] is apparent. Additional information regarding this case is presented in a later paragraph.

III. DISSEMINATED OSSEOUS TUBERCULOSIS ROENTGENOGRAPHICALLY DEMONSTRATED

Our purpose in establishing this category as a major group is to emphasize the relatively frequent occurrence of diagnosable roentgen manifestations of this process. Although a detailed discussion of the mechanism of osseous dissemination of tuberculosis is not within the range of this report, nevertheless, several salient facts reflecting current concepts deserve mention. The problem has been most recently presented by Auerbach.[1] This author does not accept the widely cited theory of Koenig, who claimed that osseous tuberculosis was the result of an obstructive embolus to the nutrient vessels, culminating in an infected, *i.e.*, tuberculous, infarct. Auerbach states that these vessels, which are indeed the seat of an obliterative endarteritis, are only secondarily implicated as the result of a precursory tuberculous infection of the bone marrow of the segment of bone involved, a view originally expressed by Heile, whom he quotes. This investigator further contends that skeletal involvement is related to hematogenous dissemination which occurs during the florid phase of the original primary complex. This dissemination results in a "seeding" of the bone marrow throughout the skeletal system. The fate of these seedings is determined by the evolution of the primary lesion. In the event of healing or encapsulation of the primary complex, there is a tendency for complete resolution of these foci. However, an occasional focus may persist or enlarge and eventually become clinically or roentgenologically evident. The latter development may pursue an extremely indolent course and become manifest only after a period of years. As pathological data in defense of his hypothesis, Auerbach indicates that only 20 per cent of his autopsied cases of

FIG. 26*a*. Case—(Previously described under Case 15). *Focal Rib Destruction Due to Tuberculosis.* This demonstrates a circumscribed area of radiolucency in the 9th right posterior rib, not previously noted on earlier studies (see Fig. 18*a*). The lesion is identical with that observed in the pelvis in this case (Fig. 18*b*). Fig. 26*b*. Shows a further stage in the evolution of the rib lesion which now exhibits productive features as well. Incidental to the examination note the regression of the originally observed pleuropericardial effusion (Fig. 18*a*) and the appearance of a right paratracheal node.

FIG. 27. Case 22. *Destructive Lesions Simulating Neoplastic Disease.* A graphic example of a destructive lesion involving the 8th right posterior rib of a patient considered to have metastatic disease. A biopsy revealed a granulomatous lesion consistent with tuberculosis. FIG. 28. Case 23. A ragged, destructive process involving the posterior segment of the 10th right rib. Simultaneous involvement of the 7th right rib is not reproduced. The destruction of the left lateral aspect of the centrum of L1 is visualized, however, a bone biopsy was positive for tuberculosis.

FIG. 29*a*. Case 24. *Disseminated Variegated Lesions of Ribs.* This film reveals areas of lysis in the 5th and 7th rib anteriorly, as well as ragged zones of destruction of the posterior 4th and 5th right ribs. Scalloping of the inferior border of the 5th right rib is also evident. This twenty-four year old Negro male presented other widely distributed osseous lesions, demonstrated immediately below.
Case—(described immediately above as Case 24). *Disseminated Osseous Tuberculosis Roentgenographically Demonstrated.* Consult legend for Fig. 29*a*, which represents the rib study in this case.

FIG. 29*b*. Illustrates the scattered irregularly contoured defects in the calvarium. Note the intradiploic location of these lesions. FIG. 29*c* and 29*d* are studies of the lumbar spine taken at a nine month interval. A lytic lesion is noted involving the posterior border of the 5th lumbar vertebra not observed in the earlier examination. Fig. 29*e* and 29*f*. These films disclose a well rounded area of radiolucency in the juxtaarticular aspect of the radial shaft. The prominent soft tissue swelling is apparent in both.

TABLE VII

ANALYSIS OF DISSEMINATED OSSEOUS TUBERCULOSIS (ROENTGENOGRAPHICALLY DEMONSTRATED)

No.	Race	Skeletal Lesions	Associated Parenchymal	Proof
1	P.R.	C_3, D_{3-5}, rt. kn. rt. ulna, lt. 5th rib	Rt. pleur. effusion	P.M. Tbc. osteomyelitis
2	N	All lumb. vert., skull, rt. radius, nasal bones		Presumptive
3	P.R.	D_{8-9}, L_{4-5}, both sacroiliac jts., lt. knee	Apical infiltrate	Presumptive
4	W	All vert., rt. knee, lt. elbow	Diffuse pulm. dis.	+cult. from draining sin., ch. wall
5	W	Mult. ribs, lumbar vert.	Pleural reaction to rib disease	+biopsy, rib
6	N	All vert., sacroiliac, 3rd rib	Cerebral tuberculoma, bilat. bas. infilt.	
7	N	D_{6-7}, D_{10-11}, 9–11th ribs, lt.		
8	W	D_{10-12}, lt. wrist, foot, rt. elbow		Presumptive
9	N	C_{-2}, D_{12}–L_1, rt. I.S. rt. wrist	Rt. epididymectomy	Presumptive
10	N	Sphenoidal ridge tbc. dactylitis	Rt. paratracheal node	Operation, biopsy
11	N	Lt. 9th rib, rt. index f., lt. elbow, rt. 11th rib	Rt. orchidectomy, old pl. effusion	
12	N	Rt. clavicle, lt. wrist, C_{5-6}, L_{-3}		Biopsy, lt. wrist

skeletal tuberculosis presented findings of chronic pulmonary disaese, a figure identical to the cited clinical conclusions of Reiser. The remaining cases showed either clear lungs, except for a healed primary lesion, or evidence of healed hematogenous foci, either pulmonary or visceral, or finally, acute terminal hematogenous spread, obviously antedated by the osseous disease.

These disseminated osseous lesions may be profuse in number, and widely separated in accordance with their hematogenous origin. The occasional complete absence of alerting symptoms is too well established to require further comment. We have collected 10 such cases (Table VII). Three patients were white, 1 Puerto Rican, and 7 were Negro. This racial distribution underlines the unique heightened susceptibility of the colored races to the tubercle bacillus.

In the instances of lesions of the spine, there is disagreement as to the significance of involvement of more than one centrum. Nathanson and Cohen, and Cleveland and Bosworth are of the opinion that multiple vertebral lesions are ascribable to the contiguous spread of the disease, by means of an extending paraspinal abscess. It is their contention that even the presence of "skipped vertebrae" does not indicate the existence of independent sites of disease and that the intervening, apparently normal vertebrae, are actually involved without demonstrable roentgenographic evidence. Although this point of view frequently obtained, nevertheless sufficient data now exist to support the opinion that, in many instances, extensive vertebral lesions are due to hematogenous spread. Auerbach states that in instances of multiple vertebral involvement, the intervening centra were frequently normal, at autopsy. Wilkinson[11] in the 1948 Hunterian Lecture before the Royal College of Surgeons declared that multiple lesions in the vertebral column are common, and that in all likelihood, the entire spine was seeded at the time of the initial blood borne dissemination. This view is also held by Feuchtwanger.[6] In our opinion, the presence of other widely disseminated, disparate bone lesions in cases which present multiple vertebral lesions, is cogent affirmation of this interpretation. Cases 1, 4, 13, 24, and 25 are

TABLE VIII

ANALYSIS OF 68 PERIPHERAL LESIONS

Part	N	W	P.R.	C	Total	Proved	Strongly Presumptive	Clin. Diagnosed
Knee	5	6	1		12	6	5	1
Hip	4	9			13	4	6	3
Os calcis			1		1			1
Finger	4	1		2	7	3	4	
Elbow	2	4	1		7	2	4	
Ankle		2			2	2		
Greater trochanter	1	2			3	1	2	
Wrist	3	5			8	2	5	1
Skull	2	1			3	2	1	
Ulna			1		1		1	
Ilium	2				2	1	1	
Shoulder	1	1			2	1	1	
Sternum	2	1			3		2	
Acromio Cl.		1			1		1	
Fibula		1			1		1	
Navicular		1			1		1	
TOTAL	26	36	4	2	68	24	38	6

representative of this type of disseminated disease.

Disseminated Osseous Tuberculosis (as a Roentgen Demonstration of Hematogenous Disease)

Case—(previously described under Case 24). Figure 29*a* is a study of the bony thorax of this patient and has been described above.

Figure 29*b* graphically illustrates the numerous, irregularly contoured defects in the calvarium.

Figure 29*c* and 29*d* are studies of the lumbar spine taken at nine month intervals. They demonstrate a lytic lesion in the posterior aspect of L_5, not present in the earlier study.

Figure 29*e* and 29*f* are views of the right radius, disclosing an easily identified, well circumscribed radiolucent area in the ventral aspect of the juxta-articular zone of the distal radial shaft The concomitant soft tissue swelling is likewise apparent.

This case is of particular interest in the light of Kraske's contention (quoted by Auerbach) that involvement of the bones of the skull reflected massive disseminated tuberculous infection. Auerbach, however, presented 5 instances of skull involvement, 4 of which represented the sole manifestation of the disease.

Case—(previously described under Case 4). In order to avoid, as far as possible, reduplication of reproductions, reference will be made to previous figures in this instance.

Figure 4*a* shows a large right hilar tuberculosis node. A lesion of the 3rd right rib is not reproducible.

Figures 4*b*, 4*c*, 9 and 12 demonstrate the previously described universal involvement of the dorsolumbar spine.

Figure 19 reveals the lytic lesion in the left sacroiliac joint.

IV. PERIPHERAL OSSEOUS TUBERCULOSIS

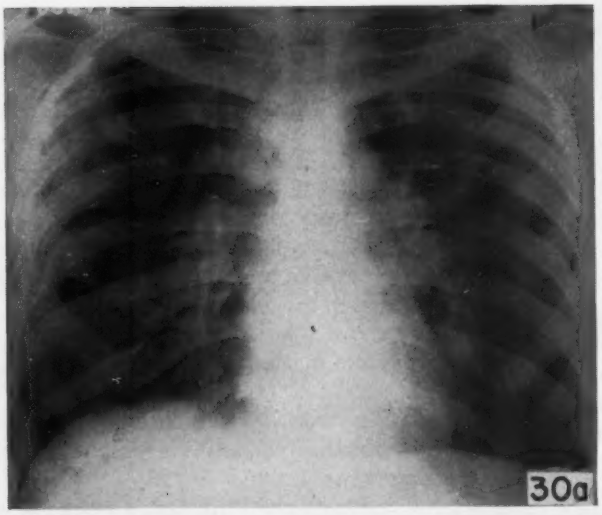
Peripheral lesions were not unusual in either site, or appearance, for the most part. We have encountered several highly unusual types of peripheral skeletal involvement which merit presentation. Of particular significance are 7 instances of tuberculous diaphysitis of the small tubular bones, a site considered to be the appanage of childhood tuberculosis. We would like to emphasize the fact that small bone involvement, like osseous tuberculosis elsewhere, is the result of hematogenous infection, whether this manifestation occurs in the presence of indisputably widespread,

29c

29d

29e

29f


30a

30b

30c

31a

31b

32a

32b

32c

33

visceral and osseous involvement (as in Case 25) or as a solitary lesion, unaccompanied by other stigmata of tuberculosis (as in Case 26). In a significant number of instances, peripheral bones mirror and participate in an active hematogenous dissemination. The cases presented adequately reflect the need for entertaining tuberculosis as a causative agent in diseases producing periosteal proliferation of small tubular bones.

Tuberculous Diaphysitis of the Small Tubular Bones

Case 25. A thirty-six year old colored male was found to have right hilar adenopathy in September, 1949. Two months later the patient complained of right temporal headaches and diplopia. On roentgen study of the skull, a lesion of the right sphenoidal wing was reported, and a craniotomy performed. A granulomatous lesion of the right sphenoidal ridge was found and a histopathological diagnosis of tuberculosis subsequently made. A year later the patient developed pain and swelling over the dorsum of the left wrist. Spontaneous rupture of the mass occurred, and culture of the contents was positive for tuberculosis.

Figure 30*a* is a later roentgen study of the chest showing bilateral hilar and right paratracheal nodal disease, as well as diffusely prominent linear and reticular marking at both bases. Figure 30*b* demonstrates the increase in bony density of the 2nd left metacarpal, the fine periosteal proliferation noted chiefly about the ulnar aspect of the shaft, and finally a marked prominence of the soft tissues about the metacarpal. The severe osteoporosis of the phalanges and carpal bones should be noted.

Case 26. A white male, sixty-two years old, first noted a swelling over the dorsum of the head of the second left metacarpal in September, 1948. The finger was incised by his local physician and only serum obtained. Following a course of radiotherapy, which was ineffectual, patient was referred to a local tumor center, where a diagnosis of osteogenic sarcoma was made. After his subsequent admission to this hospital, histopathological study of a biopsied specimen taken from the involved metacarpal disclosed the presence of tuberculosis.

Figures 31*a* and 31*b* disclose extensive periosteal reaction about the 2nd left metacarpal. The intensity of the periostitis simulates that of a nonspecific osteomyelitis or malignant bone disease.

Case 27. This twenty-eight year old Chinese male injured his right index finger in February, 1944. The metacarpophalangeal joint and adjacent phalanx remained tender and swollen, and after one month an incision and sequestrectomy was performed. A histopathological diagnosis of tuberculosis followed. He later developed disease of L5-S1, and ultimately bilateral pulmonary tuberculosis.

Figures 32*a* and 32*b* disclose a marked soft tissue swelling about the metacarpophalangeal joint of the right index finger, in addition to a smooth periosteal elevation, cloaking the entire proximal phalanx.

Figure 32*c* is a follow-up study showing marked destruction of the involved joint with dislocation of the proximal phalanx on the metacarpal. The soft tissue swelling persists.

A site of peripheral osseous tuberculosis which warrants attention is the greater trochanter of the femur. Three such cases

Fig. 30*a*. Case 25. *Tuberculous Diaphysitis of the Small Tubular Bones.* This is a study of the thorax showing bilateral hilar and right paratracheal nodal disease. A diffuse reticular and linear infiltrate is present in both bases. Fig. 30*b* and 30*c*. These demonstrate an increase in density of the entire 2nd left metacarpal, as well as a pronounced increase in soft tissue density about this bone. The striking degree of osteoporosis of the adjacent osseous structures is evident. Fine periosteal proliferation is noted best on the oblique study of the metacarpal (Fig. 30*c*).

Fig. 31*a* and 31*b*. Case 26. A-plane oblique projections of the metacarpal. The intensive periosteal cloaking about the interior shaft is manifest. Reactive focal soft tissue swelling is also demonstrated.

Fig. 32*a* and 32*b*. Case 27. Striking examples of periosteal proliferation about the diaphysis of the second right metacarpal. The soft tissue swelling is again evident. Fig. 32*c*. This shows the ultimate disintegration of the involved metacarpophalangeal joint with subluxation of the proximal phalanx.

Fig. 33. Case 28. *Tuberculous Osteitis of the Greater Trochanter.* Demonstrates a combined destructive and productive lesion of the left greater trochanter. This appearance is indistinguishable from an osteitis secondary to nonspecific peritendinitis, rheumatoid osteopathy and occasionally lymphomatous disease.

TABLE IX

GENERAL DISTRIBUTION OF SKELETAL LESIONS

I. *Axial Skeleton*		
1. Cervical	9	
2. Dorsal	36	
3. Lumbar	26	
4. Sacroiliac	24	
	95	
II. *Ribs*	13	
III. *Peripheral*		
48 cases (68 lesions)		
24 proved		35%
38 strongly presumptive		56%
6 clinically diagnosed		9%
68		100%

are included in this report. In one of these cases, no other demonstrable tuberculous involvement was shown. Again, the combined lytic and eburnative lesions may co-exist, as has been heretofore noted in the study of the axial skeleton, although the lytic form predominates. We have found that tuberculosis of the greater trochanter may simulate osteitis secondary to non-specific peritendinitis, rheumatoid osteopathy (Guest and Jacobson[8]) and rarely, in our personal experience, lymphoma.

CASE 28. After an injury to the left hip, sustained in 1942, this fifty-four year old white male complained of persistent pain which became slowly but progressively more intense. Finally, in 1945, he was admitted to the hospital with swelling in the region of the left greater trochanter. He gave a history of a right epididymectomy for tuberculosis eight years prior to admission.

Roentgenographic examination (Fig. 33) demonstrates a combined destructive and productive lesion of the left greater trochanter. Aspiration and culture proved positive for tuberculosis.

Statistical Correlation between Skeletal and Systemic Tuberculosis

Fifty-six cases had either an associated active, chronic pulmonary or co-existing renal lesion. In 34 cases, the bone lesion was associated with an active pulmonary lesion (approximately 20 per cent). In 33 cases, *i.e.*, approximately 20 per cent, there was co-existence of tuberculosis of either the urinary system (18 cases) or genital tract (15 cases). These figures parallel those of Auerbach[1] very closely. In 8 cases, there was associated skeletal, renal and pulmonary tuberculosis.

SUMMARY

1. A report analyzing 156 cases of bone and/or joint tuberculosis has been presented.

2. These cases have been segmentally catalogued and analyzed according to race, proof, and type of lesion.

3. The strikingly unusual forms of tuberculous disease of the spine including lytic, production and proliferative types, have been illustrated and stressed. The incidence of productive changes of the dorsal and lumbar spine in this series is 18 per cent.

4. The unusual frequency of sacroiliac disease has been emphasized and the morphological types and site of joint involvement indicated. Twenty-four such cases were reviewed.

5. Thirteen rib lesions have been culled and their frequency and morphologic variation, and more especially their significance, have been discussed.

6. The relatively frequent occurrence of roentgenographically detectable manifestations of hematogenous dissemination of the skeletal system has been demonstrated.

7. Forty-eight cases of peripheral and/or joint tuberculosis, including a total of 68 osseous lesions, have been tabulated according to race, type and site of disease.

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We are indebted to Dr. Charles Gottlieb for his help and suggestions in the preparation of this manuscript.

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INTERVERTEBRAL DISC FISSURES (VACUUM INTERVERTEBRAL DISC)*

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DISTINCT radiolucencies in the intervertebral discs are seen rather commonly on lateral roentgenograms of the lumbar spine. However, many radiologists and orthopedists have overlooked this phenomenon, and it has received little attention in the literature. Once recognized, its appearance becomes quite obvious.

These radiolucencies were first described as "vacuum intervertebral discs,"[2,3] and they have also been called "phantom nucleus pulposus."[1] Usually, they are seen as ovoid areas of decreased density in the lumbosacral joint spaces, associated with narrowing of the joint spaces and reactive changes at the joint margins. The evidence available indicates that the radiolucencies are due to disc degeneration which produces a cracking or fissuring of the disc substance. For this reason, the term intervertebral disc fissure is suggested as most descriptive of the anatomic change present.

CLINICAL DATA

In a period of about four years, and in an estimated 3,500 roentgen examinations of the lumbar spine, I recorded more than 30 clear-cut instances of this phenomenon. Of 30 patients whose records were studied, 23 were men. Their ages ranged from forty to eight-three years. Most, but not all of them, were seen because of back pain, with no typical symptoms or clinical findings. The duration of the pain ranged from a few days to more than twenty years, the average estimated period being eight to ten years. Only one patient gave a history of definite trauma and more or less consistent pain after the trauma. Several gave histories of a vague back injury, many years before, but had no symptoms until relatively recently. The majority remembered no back injury. In some instances the pain was not at the level of the fissure. In none were there classical findings of posterior protrusion of the nucleus pulposus. The lesions of 2 patients were seen incidentally in the lumbar spine on roentgenograms of the abdomen. Twenty were in the lumbosacral joint, 9 in one or more lumbar interspaces, and 1 in a cervical interspace.

ROENTGENOGRAPHIC FEATURES

Study of these roentgenograms suggests that the radiolucencies have two fairly distinct patterns in location and appearance. Nearly all of those in the lumbosacral joint spaces are centrally located and more or less ovoid in shape (Fig. 1). This conforms to the location of the nucleus pulposus, and indicates that the nucleus pulposus is primarily involved. There is clearly an absence of tissue, solid or liquid, which leaves the space seen as a radiolucency and in which

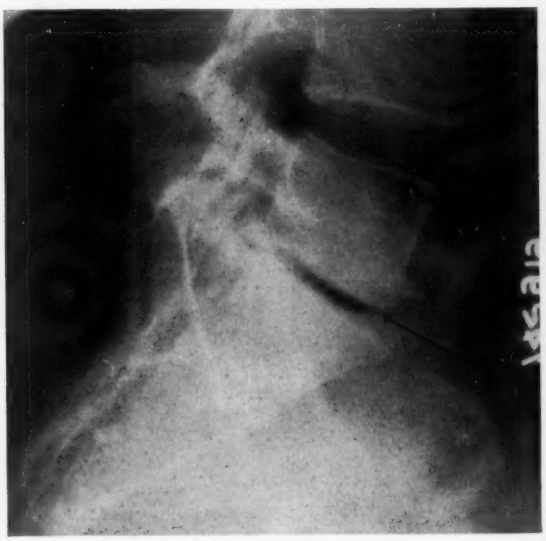

FIG. 1. Rarefaction in lumbosacral joint space. Note narrowing of space and marginal reactive changes.

* Presented at the Annual Meeting of the Pacific Northwest Radiological Society, Spokane, Washington, May 6, 1950.

there must be a partial vacuum. In these cases there is always joint space narrowing, with marginal sclerosis and osteophyte production. In a few cases the radiolucency is rather anterior in the joint space, and in 2 instances it gives the impression of discrete rounded globules or bubbles toward the anterior margin of the disc (Fig. 2).

Most of the radiolucencies in the lumbar interspaces have an entirely different appearance, showing relatively long thin streaks toward the edges of the intervertebral discs. Some of these lines seem more or less circular, at times suggesting a wishbone configuration. They give the impression that they lie between the cartilage of the vertebral bodies and the fibrocartilage of the disc. The radiolucencies in this area are frequently associated with unilateral narrowing of the interspace, and unilateral productive changes. However, in a few instances there is no discernible diminution of the joint space, and in these the finding of a radiolucency is the only evidence of intervertebral disc change. In this last group, the phenomenon is seen in some patients at more than one level. In one patient four interspaces were involved (Fig. 3).

In each of the several cases in which it was attempted, forced extension (lordosis) of the spine brought the fissure into much

Fig. 2. Slight multiloculation of rarefaction in lumbosacral joint space. Narrowing and reactive changes are shown.

Fig. 3. Multiple disc rarefactions having a marginal rather than a central position and a tendency to wishbone configuration. Minimal narrowing and reactive changes.

greater prominence. One patient was maintained in extension for thirty minutes with no change in the appearance of the disc defect. Conversely, with forced flexion of the spine the radiolucency disappeared immediately (Fig. 4). The rapid appearance and disappearance of the radiolucency indicates that the space is occupied by a vacuum rather than by air.

One patient whose roentgenograms showed a fissure was subjected to spinal fusion for "instability." Subsequently the fissure was not present.

DISCUSSION

The phenomenon of "air" in the intervertebral space was first mentioned by Magnusson[3] in 1937. However, the only detailed consideration of the subject found in the literature is that of Knutsson[2] in 1942. He was of the opinion that the vacuum intervertebral disc, as he termed it, is pathognomonic of disc degeneration, and that aside from disc calcification it is the only roentgenologic finding that can be directly referred to disc substance. He described the pathologic finding of cracks

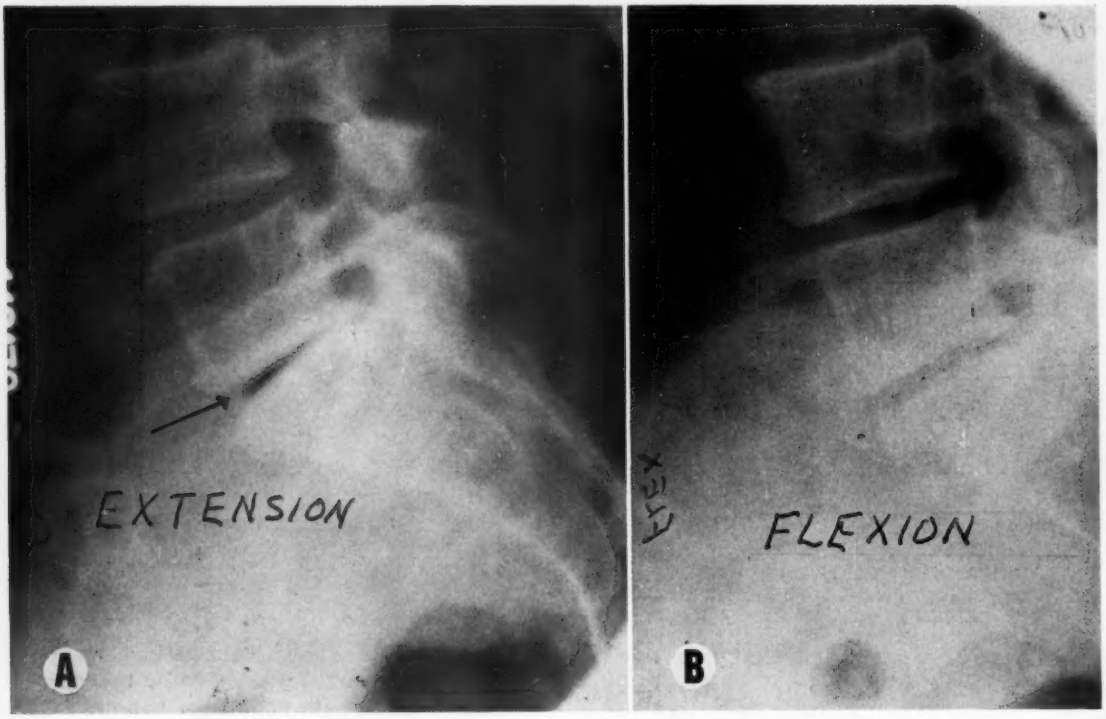

FIG. 4. (*A*) Disc fissure demonstrated in extension (lordosis). (*B*) Rarefaction immediately disappears on flexion of spine, same patient.

in the fibrocartilage of degenerating discs, presumably due to desiccation of disc material, and observed that motion of the vertebral bodies tends to separate these fissures, leaving spaces which are more or less of a vacuum. Thus, extension of the spine opens the cracks, making them visible roentgenologically, and flexion closes them. Knutsson believed that in other cases there is a breaking away of parts of the annulus fibrosus, permitting some retraction of the disc and leaving the nucleus intact. This would explain the linear circular radiolucencies seen in some of my roentgenograms. Knutsson stated that the finding of the radiolucency alone, without joint space narrowing or other evidence of disc abnormality, is sufficient evidence to diagnose disc degeneration.

SUMMARY

Radiolucencies in the intervertebral discs are not rare.

They represent a vacuum space in fissures remaining when parts of the disc degenerate. Because of this origin, the use of the term intervertebral disc fissure is suggested.

Lateral views of the lumbar spine, made in forced extension, give optimum visualization of the fissures.

The fissures have no more significance than any other evidence of intervertebral disc degeneration.

Thirty cases of intervertebral disc fissure are reviewed. These show no apparent relation to acute trauma or to protrusion of the nucleus pulposus.

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Vol. 70, No. 6

AN EXTRACRANIAL MENINGIOMA WITH NO APPARENT INTRACRANIAL SOURCE*

REPORT OF A CASE

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WHILE reviewing all of our intracranial meningiomas preliminary to reporting those of the sphenoidal ridge,[5] we came upon a case which we believe is sufficiently interesting and unusual to report, namely, an extracranial meningioma with no apparent intracranial source. To our knowledge no similar case has been described.

Meningiomas are thought to arise from arachnoid cells which form caps over the arachnoid villi.[1] The origin of the arachnoid is still somewhat in doubt. In 1935 Globus[4] presented the concept that all three of the meninges arise from a mesenchymal tissue which fills the space between the skin and the neuroectoderm; he referred to this as skeletoneural intertissue. This mesenchymal tissue then splits into two parts, an internal and an external. The internal part becomes the pia and the arachnoid, and the external part the dura and the periosteum. Globus is of the opinion that meningiomas arise from this primitive mesenchymal tissue, and that, in this manner, they may acquire the character of any of the component layers of the meninges. He regarded them as compound tumors in which either the parenchymatous, epithelioid element, or the fibroblastic, stromal element may predominate.

Extracranial intraorbital meningiomas within the sheath of Schwalbe have been reported,[1,2,3] but these are either extensions from an intracranial lesion or possibly are primary in the arachnoid layer of Schwalbe's sheath.

REPORT OF CASE

The following case report is of an extracranial meningioma growing where normally no arachnoid cells are present:

C.A., a twenty-three year old white male entered the Hospital of the University of Pennsylvania, November 26, 1930, complaining of a swelling on his forehead and deafness of about five years' duration.

Past History. At two years of age he fell against a hot stove and sustained a rather severe burn on his left forehead.

Present Illness. In 1925, at the age of eighteen, he bumped his left forehead over the site of the old burn. It was not a very hard blow and he did not lose consciousness, but about one month later he noted that a small lump had formed at this site. He also realized he was getting deaf and this seemed to be more pronounced in the left ear. In 1929 he noticed a definite weakness of his left hand and face. From 1929 to 1930 the lump, the deafness, and the weakness of his

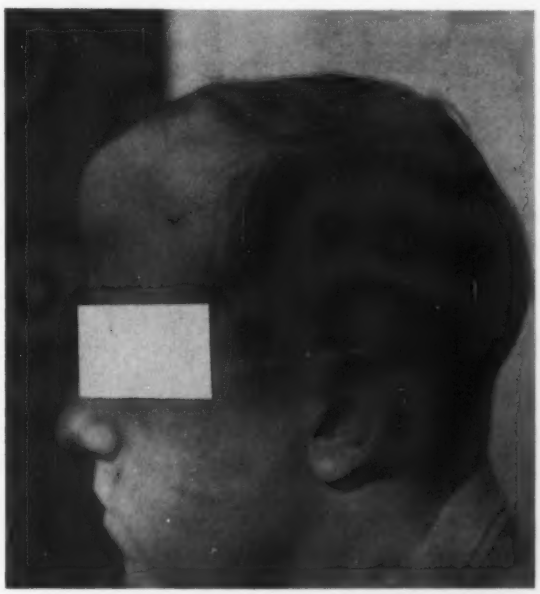

FIG. 1. Photograph of the patient showing the prominent round mass over the left frontal region.

* From the Department of Radiology, Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania, and the Penn Mutual Life Insurance Foundation for the Study of Neoplastic Disease.

FIG. 2. Posteroanterior roentgenogram showing the area of increased bone density in the left frontal region which seems to extend across the midline into the medial portion of the right frontal region (arrows).

left hand and face all gradually increased in size or extent.

Physical Examination. When first seen by us (November, 1930) there was a hard rounded mass 6 to 8 cm. in diameter over the left frontal region which projected 2 to 3 cm. above the normal level of the skull (Fig. 1).

Neurological Examination. This indicated a flaccid paralysis of the extensors of the left hand and face, a paresis of the extensors of the left forearm and slight paresis of the left lower extremity. The right optic disc was obliterated at the margins and the right palpebral fissure was smaller than the left. A lens opacity of the left eye prevented examination of the left fundus. A left central facial paralysis, bilateral deafness more pronounced on the left and atrophy of the left side of the tongue were also present. Cerebrospinal fluid pressure was 220 mm. of water.

Roentgen Findings. These disclosed a diffuse area of increased bone density intermingled with areas of rarefaction in the left frontal area which crossed the midline to the right and also extended fairly far backwards on the left lateral side of the frontal bone. Both choroid plexuses were calcified. The pituitary fossa was normal (Fig. 2 and 3).

Operative Procedure. On December 13, 1930, Dr. Charles H. Frazier performed a left frontal craniectomy with removal of a bone tumor which measured 7 by 10 cm. in diameter. There were no adhesions between the bone and the underlying dura which appeared perfectly normal. Normal brain cortex was found beneath the dura.

At operation it appeared as though the whole tumor was simply an osteoma.

Pathological Findings. Gross Examination: The specimen consisted of a piece of bone removed from the frontal region of the skull. It was irregularly thickened and denser than normal bone. In one portion on the external surface there was a firm swelling shaped like a hillock and covered by a layer of soft tissue 0.75 cm. thick, which was white, homogeneous and firmly adherent to bone (Fig. 4, *B*). Around the edges of the swelling the bone was thin. The inner table of the skull was corrugated and roughened, but there was no gross evidence of tumor. The cut surface of the bone was dense, hard and thickened (Fig. 4, *A*). *Microscopic Examination:* On the outer table there is a well encapsulated tumor consisting of fibroblastic

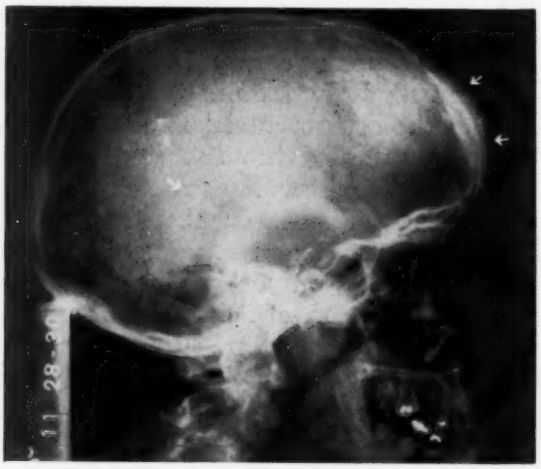

FIG. 3. Left lateral roentgenogram showing the area of bone proliferation in the frontal region (front arrows). Several small areas of rarefaction are seen within the hyperostosis. The entire area of hyperostosis extends back nearly to the coronal suture. The posterior arrow points to the calcified choroid plexuses.

cells with bright round or oval nuclei and poor differentiation of the cell borders. The cells are arranged in small lobules surrounded by a moderately thick stroma of collagen connective tissue. No psammoma bodies are seen. *Diagnosis:* Meningioma, arachnoidal, Type 1, variant 1 (Fig. 5, *A* and *B*).

Subsequent Course. The patient was very uncooperative and became involved in several compensation lawsuits. In 1931 he re-entered the hospital but refused examination by an encephalogram. In 1932 he again entered the hospital at which time his neurological status was unchanged and he again refused to have air studies. He died on October 15, 1940, and no autopsy was obtained.

DISCUSSION

As has been already pointed out regarding this patient, at operation no intracranial tumor was found and the dura appeared normal. Dr. Charles H. Frazier, who performed the operation, was surprised to learn of the pathological diagnosis as he thought he had removed a benign osteoma.

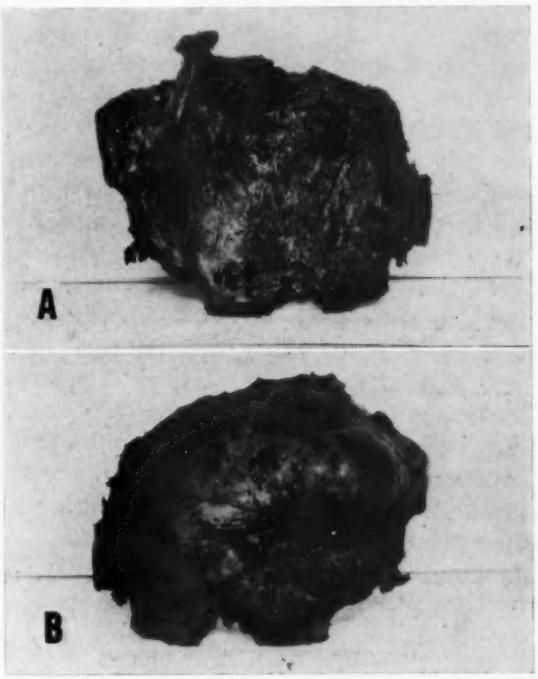

Fig. 4. Photograph of the resected bone specimen. (*A*) This view shows the internal surface which is roughened and corrugated, but there is no gross evidence of tumor. (*B*) This view shows the external surface with the hillock of tumor tissue.

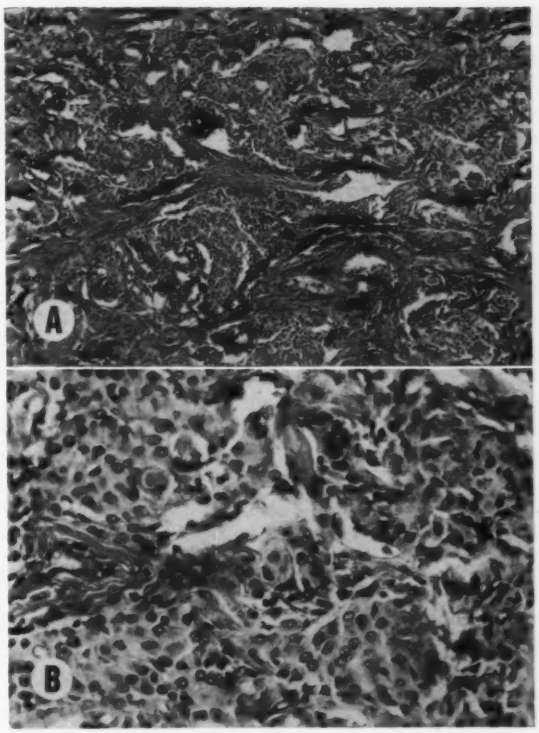

Fig. 5. Photomicrographs of the tumor which lay on the external table of the resected bone specimen. (*A*) Low power (×90) photomicrograph (hematoxylin and eosin stain) showing a meningioma Type 1, variant 1. (*B*) High power (×315) photomicrograph (hematoxylin and eosin stain) showing a meningioma Type 1, variant 1. (Photomicrographs courtesy of Armed Forces Institute of Pathology. Accession number: 218237-5 and 218237-6.)

From a study of the microscopic findings there is no doubt of the diagnosis. The question is, of course, where did the tumor on the outer surface of the bone come from? We are unable to answer definitely this question, but it seems logical to hypothecate that it arose from an arachnoid cell rest which, during the embryological development of the skeletoneural intertissue, happened to lodge on the outer table of bone.

SUMMARY

A case history is presented of a patient who had an extracranial meningioma arising on the outer table of the frontal bone which had no intracranial origin or extension. This is a unique case in that to our

knowledge no similar finding has ever been reported.

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We wish to thank Francis C. Grant, M.D., Professor of Neurosurgery, School of Medicine, University of Pennsylvania, for permission to report this case.

We are indebted to the late Frederic H. Lewey, M.D., Professor of Neuroanatomy, Graduate School of Medicine, University of Pennsylvania and Associate Professor of Neuropathology, School of Medicine, University of Pennsylvania and also to Eugene B. Spitz, M.D., Instructor in Neurosurgery, School of Medicine, University of Pennsylvania, for reviewing the pathology of this case.

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PULMONARY HAMARTOMA*

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THE term "hamartoma" according to Albrecht[1] is defined as "tumor-like malformations in which occur only abnormal mixing of the normal components of the organ. The abnormality may take the form of change in quantity, arrangement, or degree of differentiation, or may comprise all the three. The deduction to be drawn from histologic examination of these formations is that they have originated in abnormal mixing of their development." The cases that Albrecht described were in the liver.

Hamartoma is a rare entity. These lesions have been variously reported as papillomas, fibroadenomas, chondromas, mixed tumors, hamartoma chondromatosum, adenochondromas and lipochondroadenomas. Albrecht[1] designated all of these mixed tumors as harmartomas. Many of these tumors embrace all of the bronchial anlagen —both mesodermal and endodermal tissues. Lesions that are called chondromas of the lung are in reality hamartomas and, according to Jones,[6] they constitute 0.25 per cent of all routine autopsy cases. McDonald, Harrington and Clagett[8] report an incidence of 0.25 per cent with 20 hamartomas in a series of 7,972 necropsies. These "chondromas" of the lung contain bronchial epithelium in clefts between cartilaginous masses and may also include mucoid, fibrous, lymphoid and muscular tissues. The term "pulmonary chondroma" is probably a misnomer and the term hamartoma should be reserved for this type of lesion.

Hickey and Simpson[5] published 2 cases of their own of "primary chondroma" of the lung and reviewed 40 cases in the literature. Their own cases contained islands of cartilage, myxomatous connective tissue, adipose tissue, mature fibrous connective tissue and papilliferous gland-like structures, covered by a single layer of nonciliated cuboid or columnar epithelial cells. In some areas the tumors were covered by stratified ciliated epithelium, and contained lime salt deposits. In the 40 cases which Hickey and Simpson reviewed from the literature, they report that the tumors generally contained the structures enumerated above, although in a few instances osteoid and osseous tissue were present.

Postlethwait *et al.*[9] report a hamartochondroma occluding a bronchus with the mass being endobronchial in location. They reported 13 other similar cases from their review of the literature.

Simon[11] considers pulmonary hemangiomas to be hamartomas. Pulmonary hemangiomas represent an alteration in quantity and arrangement of normally occurring structures of that particular organ. It may be of the type to produce polycythemia, clubbing of the fingers, cyanosis, and variable degrees of dyspnea. While a hemangioma conforms to Albrecht's definition of hamartoma, it appears that hemangioma is a more descriptive term. Hall[3] felt that many of the hemangiomatous lesions of the tongue, liver and spleen, as well as some fibromas of the kidney and rhabdomyomas of the heart, were hamartomas. Adenoma sebaceum, tuberous sclerosis, Lindau's disease, phacoma of the eye, and neurofibromatosis have been considered by some investigators to be examples of hamartomas although this may be far fetched.

Although pulmonary hamartoma is gen-

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erally considered to be a benign lesion Verga[12] reported a tendency to invasion in one of his cases and listed several examples where metastases had apparently occurred.

The size of a hamartoma may vary in size from less than 1 centimeter in diameter to a very large proportion. Jones described a case where the hamartoma was so large that it occupied all of the right upper lobe of the lung. This is uncommon. The usual pulmonary hamartoma measures several centimeters in diameter.

SEX, AGE AND LOCATION

The incidence is generally considered higher in men in the proportion of 2 or 3 to 1. There is no significant age distribution. Many of these tumors are discovered at necropsy on older individuals but with the advent of routine roentgenographic chest surveys it is anticipated that these lesions will be found more often in younger individuals.

Pulmonary hamartomas are said to be usually peripheral and generally just below the pleural surface. However, they may occur anywhere in relation to the bronchial tree and pleural surface.

SIGNS AND SYMPTOMS

If pulmonary hemangiomas may be considered hamartomas, then one may expect polycythemia, clubbing of the fingers, cyanosis and dyspnea. However, hamartomas frequently produce no abnormal symptoms or signs, although Sherwood and Sherwood[10] have claimed that cough, pain and dyspnea were the three symptoms most frequently observed. This is concurred in by Lemon and Good.[7] The occurrence of a pulmonary hamartoma is frequently first suspected on a routine chest roentgenographic examination.

DIAGNOSIS

A pulmonary hamartoma is generally spheroid and may be lobulated. The lesion is usually sharply circumscribed and well demarcated with no surrounding infiltrate. Calcification and sometimes osssification may be noted within the contour of the lesion. Hall reported 4 cases of pulmonary hamartoma all of which contained demonstrable calcium in the roentgenograms. In the series of 17 cases reported by Lemon and Good, 11 showed evidence of calcification or ossification. Calcification was noted in 1 of our 3 cases by roentgenography and ossification was seen in another case microscopically (see below).

One of the characteristic features is the indolence of hamartoma. This lesion generally does not change in size or shape over a period of time which may be measured in years. One of Hall's cases was followed for five years and another twenty-one years by repeated roentgenographic examinations with no demonstrable increase in size. This latter case showed an apparent increase in the amount of calcification while under observation. One of our own cases was followed for twelve years and showed probably a very slight increase in size (apparent growth of 0.5 cm. in one diameter) which we cannot completely account for on technical factors.

In those instances where a hamartoma (hamartochondroma) arises from the inner wall of a bronchus there may be obstructive emphysema present initially followed by atelectasis and areas of obstructive pneumonitis.

Hall, Hickey and Simpson, and others, have maintained that the roentgen appearance of a pulmonary hamartoma is sufficiently characteristic for an accurate diagnosis. This opinion is not shared by Lemon and Good on the basis of their own experience, and we feel quite strongly that an accurate diagnosis without thoracotomy is impossible in most instances.

Bronchoscopic examination is usually of no value since most of the hamartomas are located in the periphery of the involved lobe. Bronchography will simply indicate a tumor mass adjacent to one of the bronchial radicles. Sectional roentgenographic studies are sometimes of benefit in demonstrating the exact contour of the lesion and in determining the presence of calcifi-

cation or ossification. Thoracotomy with biopsy is generally the only definitive measure for establishing a diagnosis.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis is that of any of the solitary, spheroid, circumscribed pulmonary densities which may present themselves on the chest roentgenogram.

1. *Peripheral Bronchogenic Carcinoma.* This lesion at inception may very well simulate a hamartoma, but it contains no demonstrable calcification and generally grows rapidly in contradistinction to the known indolence of hamartoma. There may occasionally be zones of breakdown within a carcinomatous mass which we have not observed or heard of in hamartoma. Metastases from peripheral bronchogenic carcinoma to the brain, bones, regional lymph nodes and other segments of the lung are very common early in the disease. Pulmonary hamartomas metastasize only very rarely, if at all.

2. *Tuberculoma.* Tuberculoma may exactly simulate a hamartoma in appearance. Calcifications within the contour of a tuberculoma are quite common (probably a good deal more so than in a hamartoma). Small, adjacent linear infiltrates or fibrotic strands may sometimes be seen, while in hamartoma the surrounding pulmonary tissues are normal. There may be other areas of involvement by tuberculous infiltrate both in the lungs and elsewhere in the body. Areas of breakdown within the contour of tuberculoma occur occasionally. Tuberculomas are less apt to grow perceptibly than bronchogenic carcinomas but a demonstrable increase in size is not rare.

3. *Chronic Lung Abscess.* Occasionally a chronic lung abscess may assume a spheroid configuration with no demonstrable breakdown and thus simulate a hamartoma in appearance. Graham and Singer[2] have reported 3 cases of chronic lung abscess containing calcification. Usually, however, the course of lung abscess is such that obvious roentgenographic evidence of breakdown occurs and the nature of the lesion becomes apparent. There may also be "spill-over" into the dependent portions of the lungs.

4. *Cysts.* Pulmonary (bronchogenous or enterogenous) cysts may be filled with fluid and simulate hamartoma in that they appear circumscribed and spheroid. Here, again, progress films will indicate the true nature of the lesion, particularly when a bronchogenous communication is established or re-established and the fluid content of the cyst is drained. There may also be a change in the size and shape of a cystic lesion on roentgenograms taken in inspiration and expiration while solid lesions such as hamartomas remain unchanged.

5. *Infarct.* Pulmonary infarcts are usually triangular in appearance shortly after their inception although they may simulate ordinary zones of pneumonitis. Hampton and Castleman[4] have demonstrated that occasionally multiple infarcts which are contiguous may present the appearance of a single solitary density simulating a hamartoma. However, the clinical history frequently suggests an infarct and the course in progress films is such that the diagnosis is generally not too difficult. The triangular or even the spheroid density which is caused by the infarct becomes smaller as weeks or months go by and residual linear densities simulating lobular areas of atelectasis are noted.

6. *Arteriovenous Angiomatosis.* There may be one or more lobulated irregular densities usually in the lower lobes and connected with the hilar density on the homolateral side by cordlike vascular densities. These densities frequently pulsate when viewed roentgenoscopically and change in size with the Valsalva and Müller maneuvers.

7. *Metastatic Pulmonary Carcinoma.* A single solitary metastatic focus in the lungs may be confused with a hamartoma, but the course of the disease is such that these solitary densities grow rapidly in size and other opacities quickly appear. Frequently the presence of a known primary focus establishes the diagnosis immediately and

there is no likelihood of confusion with a hamartoma.

It should be noted that in the 2 cases of pulmonary hamartoma reported by Hickey and Simpson, one patient had an associated carcinoma of the stomach and the other carcinoma of the prostate. In the 40 cases which they reviewed from the literature 2 had associated carcinoma of the prostate and one bronchogenic carcinoma. Thus it is apparent that occasionally an individual with a primary extrapulmonary carcinoma may additionally have a pulmonary hamartoma. This fact becomes of importance in considering operability.

We have intentionally omitted a discussion of the symptoms and signs on physical examination as well as the pertinent laboratory data in the entities enumerated above. They are too well known to merit amplification. The roentgen chest findings generally are crucial in evaluating the situation. But the differential diagnosis may be difficult, particularly in peripheral bronchogenic carcinoma and tuberculoma. A punch biopsy done through the chest wall is theoretically possible but practically very difficult. Biopsy done during thoracotomy remains the basic definitive diagnostic measure.

TREATMENT

Since thoracotomy and microscopic sectional studies are necessary to establish a diagnosis of pulmonary hamartoma, local excision is the treatment of choice. This is particularly urgent in those instances where a pulmonary hamartoma (hamartochondroma) is endobronchial and causes obstructive phenomena. The consideration of malignant change and thus wider removal (lobectomy or pneumonectomy) is not an important one, in our opinion, Verga's statements to the contrary.

CASE REPORTS

CASE 1. A white male, aged sixty, was admitted to the hospital November 28, 1949, because of a right inguinal hernia of fifteen years' duration. A month previously his private physician had discovered a nodule in the right lung during a roentgenographic examination and had diagnosed this nodule as "lobulated neoplastic dis-

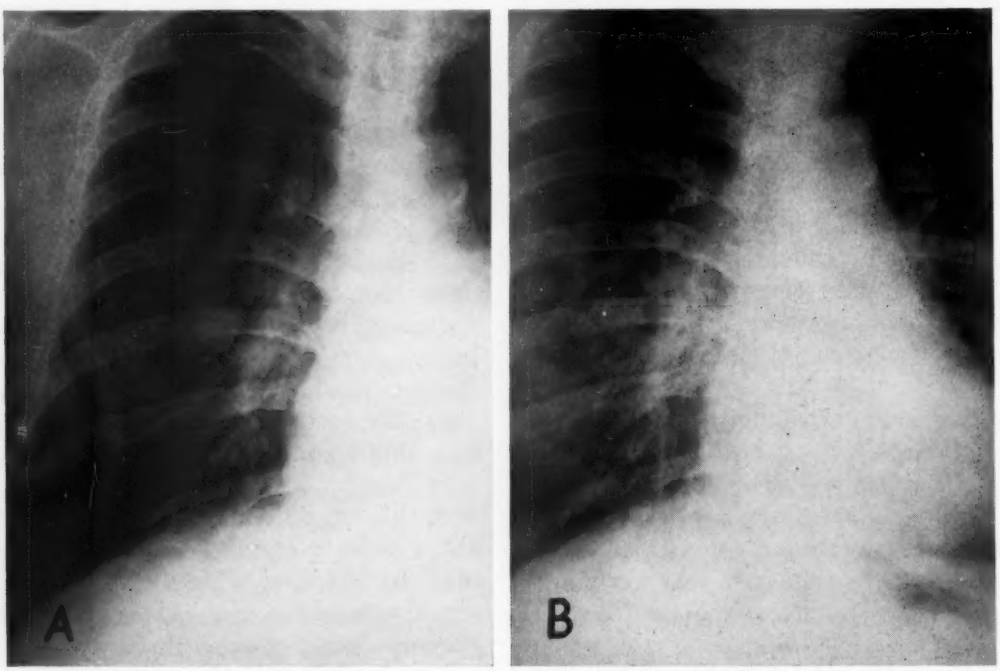

FIG. 1. Case 1. (*A*) Posteroanterior chest roentgenogram dated January 17, 1949, demonstrating mass in right mid-lung. Surrounding lung structures normal. (*B*) Posteroanterior chest roentgenogram dated November 2, 1949, identifying same mass with no increase in size.

ease." There was no significant respiratory history or any other symptoms. The patient was an excessive smoker.

Examination. The patient was a well developed, slightly obese white male, not appearing seriously ill. The positive physical findings included bilateral inguinal hernias and moderate prostatic enlargement. There was a 2 cm. soft mass in the right posterior neck which was felt to be a lipoma. The physical examination was otherwise normal. Roentgenograms of the chest (Fig. 1*A* and *B*) showed a spheroid well circumscribed density in the right mid-lung which measured 2 by 2 cm. The lungs were otherwise clear. Laminagraphic studies showed no evidence of calcification in the lesion. Roentgenographic examination of the gastrointestinal tract and gallbladder was normal, and a skeletal survey showed no abnormality. Except for a mild trace of sugar on repeated urine examinations, all laboratory studies were within normal limits.

Course in Hospital. On December 11, 1949, the right inguinal hernia became incarcerated and an emergency herniorrhaphy was done, with uneventful recovery. The patient was transferred to the chest service and on December 30, 1949, a right-sided thoracotomy was performed. A solitary, discrete tumor of the right lower lobe lying immediately adjacent to the interlobar fissure was found. The tumor was shelled out completely and a frozen section was reported as a "benign tumor." The postoperative course was entirely uneventful and the patient made a full recovery.

Pathological Report. A gross specimen consisting of a circular mass measuring 2 by 2 cm. was sectioned. The external surface appeared to be a fibrous capsule which was hemorrhagic and on section showed mucoid, firm cartilaginous tissue and a few whitish areas. Microscopic examination showed nodules of cartilage with intervening connective tissue and fat enclosing narrow spaces lined by single-layered cuboid nonciliated epithelium (Fig. 2). The microscopic diagnosis was pulmonary hamartoma (benign).

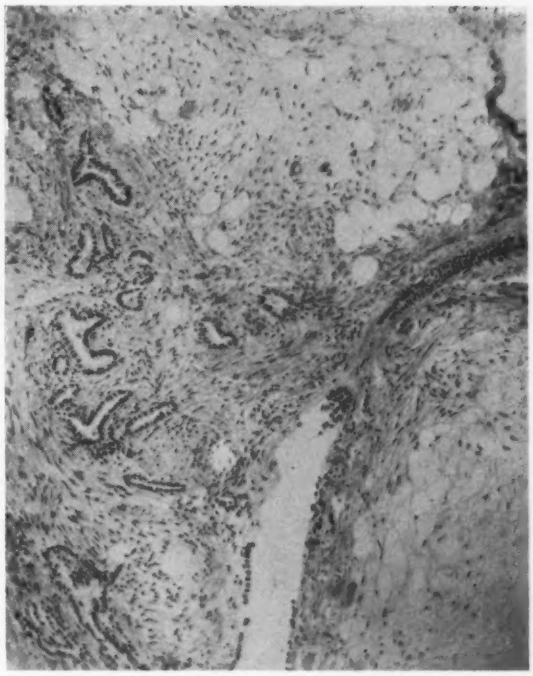

Fig. 2. Case 1. Photomicrograph showing bizarre arrangement of bronchi. Hematoxylin and eosin. ×100.

Case 11. A Negro male, aged fifty-three, was admitted March 16, 1951, with a story of a mass in the right lung discovered on a routine chest examination before coming to the hospital. The patient complained of a cough of about ten years' duration which was productive of about 2 tablespoonsful of dark, mucoid, nonfoul sputum daily with no history of hemoptysis. There were no other significant symptoms.

Examination. The patient was a well developed, somewhat obese male, not appearing seriously ill. The pertinent abnormal physical findings were a mild hypertension, central opacities in the eyes, slight left heart enlargement and a Grade 11 systolic murmur at the base of the heart. There were also atrophy of the left testicle and questionable enlargement of the prostate. The remainder of the physical examination demonstrated no significant abnormalities.

Chest roentgenographic studies (Fig. 3*A* and *B*) showed a spheroid density in the right midlung measuring 2.5 by 3.0 cm. Laminagraphic studies (Fig. 4*A* and *B*) through this area showed punctate calcifications within the contour of this mass. Other roentgenographic studies, including barium enema, gastrointestinal series and intravenous urography were normal.

Laboratory Studies. Hemogram, urine analysis, sedimentation rate, and blood chemical studies were all within normal limits. Papanicolaou-prepared sputum from bronchoscopy showed no neoplastic cells. The PPD tuberculin test in the first strength was positive with a 2 plus reaction in forty-eight hours.

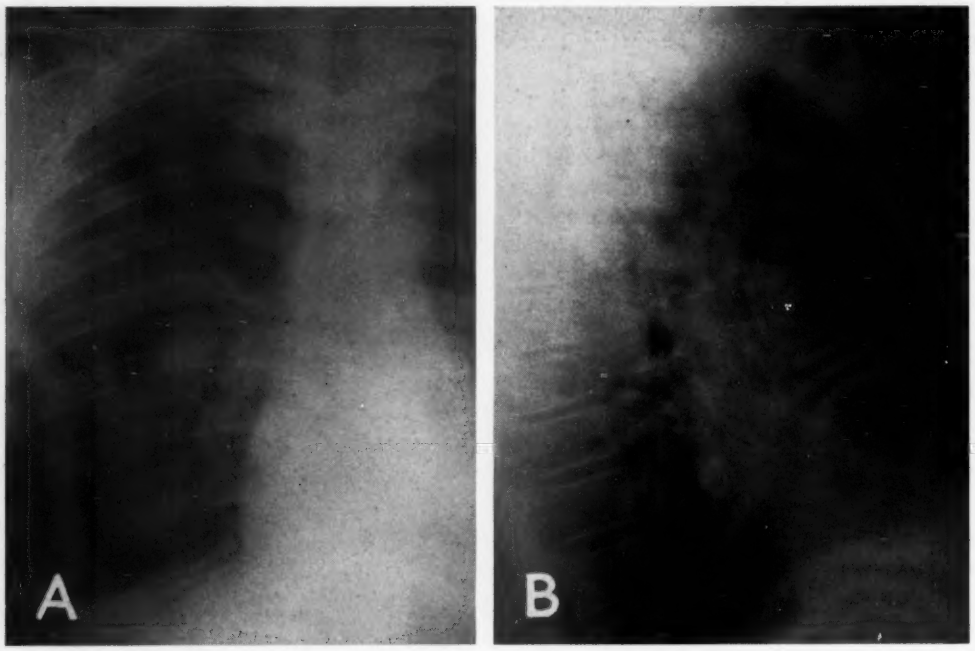

FIG. 3. Case II. (*A*) Posteroanterior chest roentgenogram dated March 19, 1951, showing mass in the right lung. Surrounding lung structure clear. (*B*) Lateral projection.

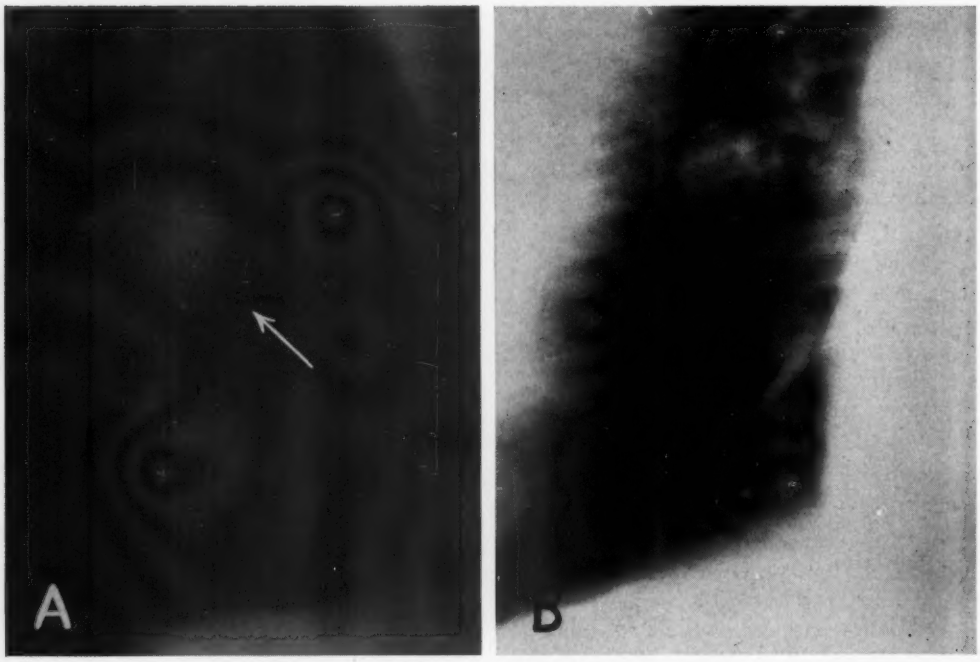

FIG. 4. Case II. (*A*) Lateral laminagram with arrow pointing to mass showing punctate calcifications. (*B*) Anteroposterior laminagram more definitively identifying calcium content.

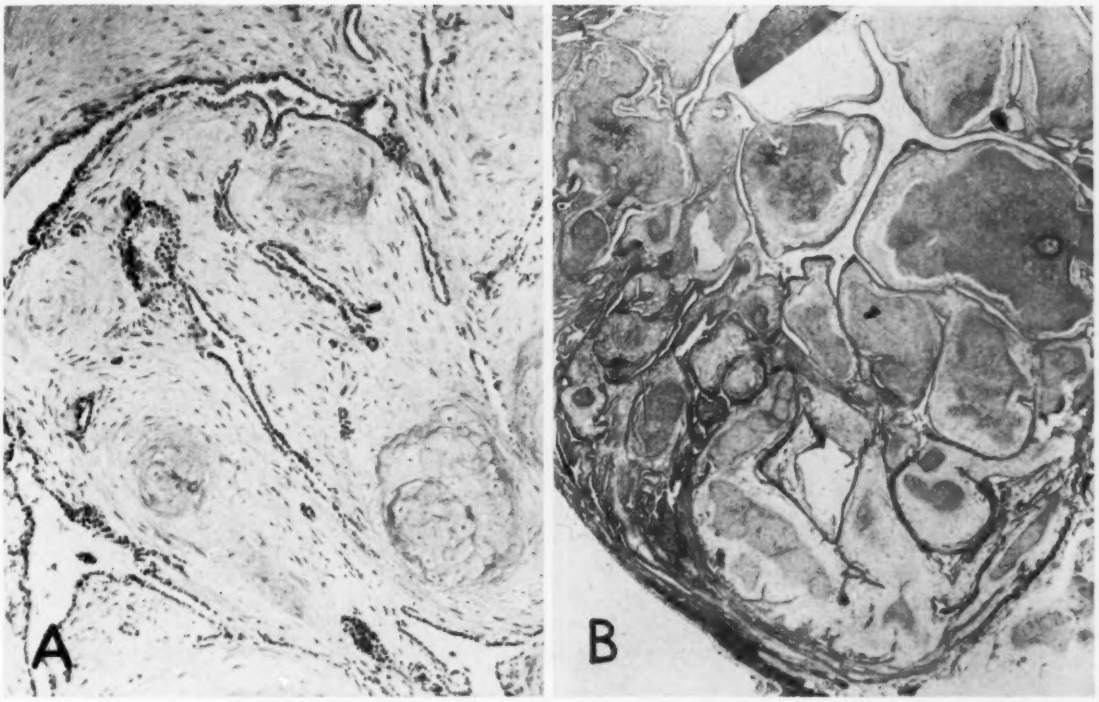

Fig. 5. Case II. (*A*) Photomicrograph showing bronchial hamartoma. Hematoxylin and eosin. ×20. (*B*) Photomicrograph with higher magnification showing benign epithelium and atypical cartilage in hamartoma. Hematoxylin and eosin. ×100.

Course. A thoracotomy was performed May 11, 1951, and the mass described in the roentgenogram was found attached to a very small bronchus. It measured 3 cm. in diameter and was located in the area of the fissure between the upper and middle lobes. The fissure itself was rudimentary and whether this mass was in the upper or middle lobe could not be clearly determined. The mass was firm, oval and was shelled out easily. The postoperative course was uneventful and the patient made a complete recovery.

Pathological Findings. On gross examination the specimen consisted of a firm nodule measuring 2.5 by 2. cm. On section the mass was seen to be composed of a central dense, homogeneous, grayish-white tissue from which radiated, toward the circumference, many large nodules. Microscopically there was a multilobed sheet of atypical cartilage with connective tissue, fat and clefts between the lobes lined by epithelium of bronchial type (Fig. 5*A* and *B*). The microscopic diagnosis was epitheliochondromatous hamartoma.

Case III. A white male, aged forty-eight, was admitted to the hospital Februray 18, 1949, for evaluation of a previously demonstrated chest lesion seen on a roentgenographic study in 1948. The patient had a bilateral herniorrhaphy in 1942 and an abdominoperineal resection with a colostomy for carcinoma of the rectum in 1931. Since 1931, the patient had complained of generalized weakness which had prevented his working over sustained periods of time. During the usual follow-up studies in 1948, a chest roentgenogram showed a small rounded nodule in the right lower lung posteriorly. Review of a chest roentgenogram (Fig. 6*A*) made in 1937 in this hospital showed the nodule to be present at that time. It measured 1.5 by 2.0 cm. In 1949 it measured 2 by 2 cm. on the chest roentgenogram (Fig. 7*B*) suggesting a 0.5 cm. increase in size in one of the diameters in twelve years.

The patient complained of a chronic cough with expectoration of a small amount of whitish mucoid sputum daily without blood or foul odor. During the month previous to admission the patient had a dull pain in the right side of the chest which was rather constant and radiated to shoulder, head and neck. The remaining history was not relevant.

Examination. The patient was a middle aged white male, not appearing seriously ill. The per-

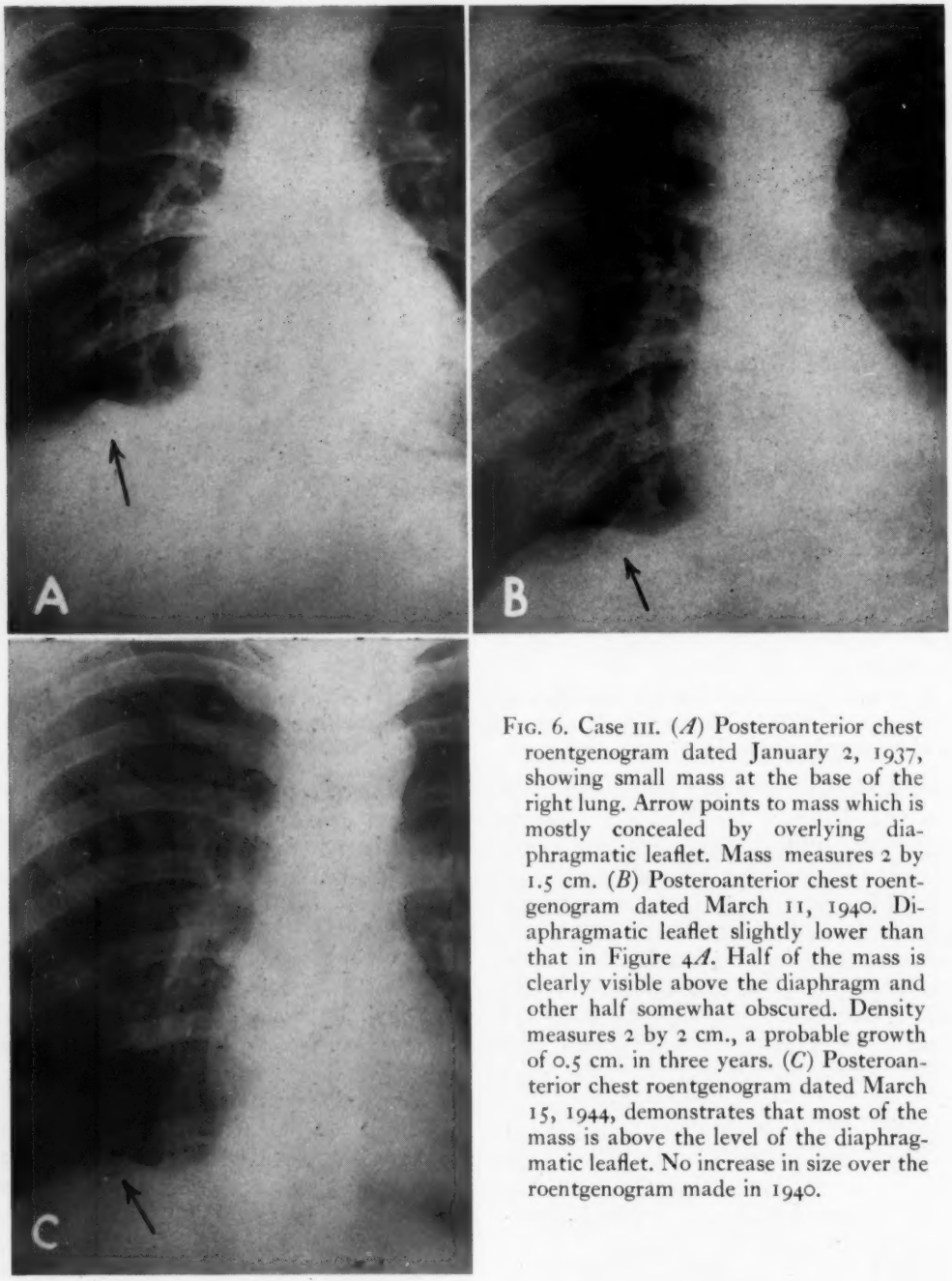

FIG. 6. Case III. (*A*) Posteroanterior chest roentgenogram dated January 2, 1937, showing small mass at the base of the right lung. Arrow points to mass which is mostly concealed by overlying diaphragmatic leaflet. Mass measures 2 by 1.5 cm. (*B*) Posteroanterior chest roentgenogram dated March 11, 1940. Diaphragmatic leaflet slightly lower than that in Figure 4*A*. Half of the mass is clearly visible above the diaphragm and other half somewhat obscured. Density measures 2 by 2 cm., a probable growth of 0.5 cm. in three years. (*C*) Posteroanterior chest roentgenogram dated March 15, 1944, demonstrates that most of the mass is above the level of the diaphragmatic leaflet. No increase in size over the roentgenogram made in 1940.

tinent abnormal physical findings consisted of a functioning left-sided colostomy, a few transient moist rales in the right base, bilateral inguinal hernias and moderate prostatic enlargement

Laboratory Data. The hemogram, urinalysis and spinal fluid examinations were normal. Sputum examination showed no acid-fast bacilli. A glucose tolerance test showed a mild diabetic curve.

Chest roentgenograms showed a spheroid circumscribed nodular density in the base of the right lung measuring 2 by 2 cm. Roentgenographic studies of the gastrointestinal tract, urinary tract and skeletal system disclosed no abnormalities except for the functioning colos-

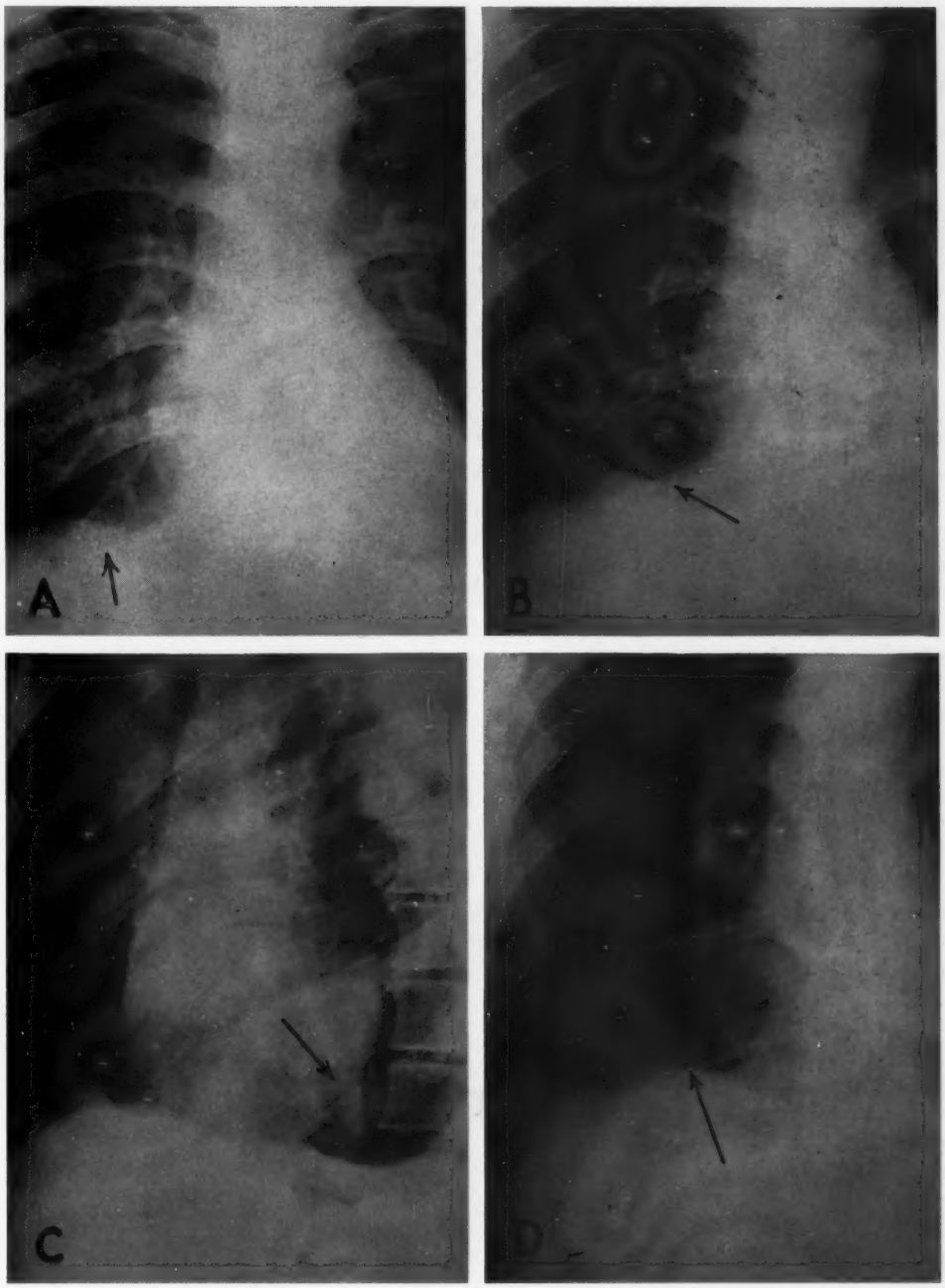

Fig. 7. Case III. (*A*) Posteroanterior chest roentgenogram dated January 26, 1945, again shows lesion below diaphragmatic level (arrow). (*B*) Posteroanterior chest roentgenogram dated March 7, 1949, showing most of mass above the diaphragmatic level (arrow). It now measures 2 by 2 cm. (*C*) Left posteroanterior oblique projection (arrow points to mass which is very clearly visualized). (*D*) Posteroanterior chest roentgenogram dated February 23, 1949, again visualizes pulmonary mass (arrow).

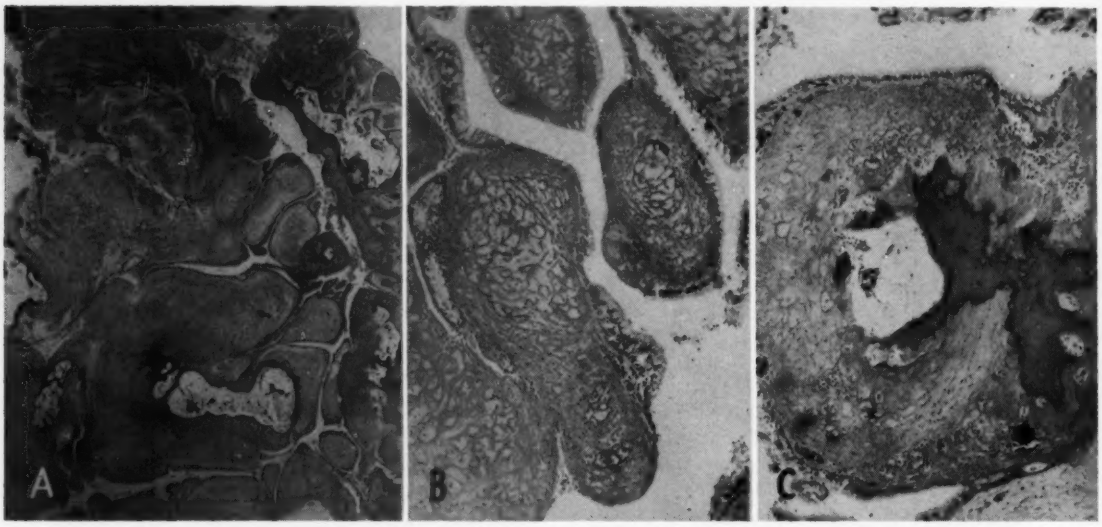

FIG. 8. Case III. (*A*) Photomicrograph showing typical features of bronchial hamartoma. Hematoxylin and eosin. ×20. (*B*) Photomicrograph—higher magnification—illustrating benign ciliated bronchial epithelium and atypical bronchial cartilage. Hematoxylin and eosin. ×100. (*C*) Photomicrograph demonstrating metaplastic ossification in atypical cartilage. Hematoxylin and eosin. ×100.

tomy described above.

Course in Hospital. On March 28, 1949, a right-sided thoracotomy was performed. A small circumscribed tumor was found in the right lower lobe, and a lobectomy was performed. The patient made an uneventful recovery after a normal postoperative course.

Pathological Report. The specimen consisted of the right lower lobe of the lung. Three centimeters from the edge of the lobe there was a rounded firmly calcific tumor measuring 2.5 by 2.5 cm. On section this mass showed a calcific surface and underlying this there was a firm, white, grumous material. Microscopically the mass consisted of bronchial type. Some of the cartilage was atypical. In places, there was connective tissue between the epithelium and the cartilage. A few areas of cartilage were ossified. (Fig. 8*A*, *B* and *C*). The microscopic diagnosis was pulmonary hamartoma (dysontogenetic bronchial formation composed of lobules of cartilage and bronchial epithelium).

SUMMARY AND CONCLUSIONS

1. Pulmonary hamartomas are defined and described and their relationship to other mixed tumors of a similar variety is reviewed.

2. The incidence of pulmonary hamartoma is discussed and the age and sex incidence is indicated

3. The common locations of hamartoma in the lung are described.

4. The clinical signs and symptoms of pulmonary hamartoma are listed.

5. The roentgen diagnosis and differential diagnosis are discussed. Particularly emphasized is the difficulty in distinguishing pulmonary hamartoma from peripheral bronchogenic carcinoma and tuberculoma, and the need for diagnostic thoracotomy is stressed.

6. Three personally observed cases of pulmonary hamartoma are presented, including a summary of the history, physical findings, roentgen appearance and the pathological reports. Roentgenograms and pathological sections in each of the three cases are appended.

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We are indebted to Dr. Benjamin B. Gordon and Dr. Amour F. Liber of the Pathology Service for their aid and cooperation in reviewing the microscopic sections; and to the Medical Illustration Service for preparing the photographs. We are also indebted to Dr. Charles Gottlieb, Consultant in Radiology, for his constructive criticism and help in the preparation of this manuscript. Our thanks are due to Miss Eve Spelke for the meticulous care in typing this manuscript.

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EXTRAMEDULLARY PLASMOCYTOMA OF THE LUNG*

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EXTRASKELETAL origin of multiple myeloma is of such unusual occurrence, as disclosed by a study of the literature, that localization in the lung becomes an extreme rarity.

In 1933 Kreibig described 2 cases of plasmocytoma in the bronchus.

In 1943 Hellwig published 128 cases of extramedullary primary foci, 50 of which were localized in the conjunctivae, 65 in the upper air passages and the remaining 13 in the lymph nodes, mediastinum, thyroid, ovary, stomach, intestines, kidney, spermatic cord and skin. In this series only 2 cases were found in the bronchus.

Hellwig and other workers differentiated the entire group of cases into noncancerous and cancerous growths, which were further classified into two groups: single and multiple foci. All reported cases of myeloma arising in the conjunctivae have been found to be nonmalignant and noninvasive. Many authors feel that these tumors in the conjunctivae should be classified as granulomas. Of all plasmocytomas localizing in the air passages reported by Hellwig, there have been only 2 cases of bronchial origin which were noncancerous and multicentric in origin. In Heindl's patient, quoted by Hellwig, the regional mass was in the nasopharynx and after its removal three years later, two new tumors developed in the trachea and two in the right bronchus.

It was Hellwig's opinion that there is no definite correlation between the cytological appearance of the histological section and clinical course. Quoting Hellwig, "the extra-medullary plasma cell tumor, in spite of typical cell structure, may range from an entirely non-cancerous growth to a cancer of high grade."

In 1944 Gordon and Walker reported a case of plasmocytoma localized in the upper lobe of the left lung, manifested as a sharply circumscribed solitary mass which was removed by lobectomy. No skeletal involvement was reported at that time.

In the literature of 1951 a case of plasmocytoma of the lung was reported by Kuley and Kuntman of Turkey. Diagnosis of this case was made by an aspiration biopsy of the mass in the lung.

In view of the scarcity of cases of extramedullary plasmocytoma of the lung, we feel justified in publishing 2 additional cases.

REPORT OF CASES

CASE 1. The patient was a male, aged fifty-six, admitted to the Bayonne Hospital and Dispensary, Bayonne, New Jersey, on May 31, 1948 by Dr. D. Simpson, with symptoms of an acute respiratory infection. Physical findings disclosed an acutely ill patient with a septic type temperature, rapid pulse, chills and cyanosis. Roentgen examination of the lungs on June 1, 1948, showed a somewhat patchy, mostly coalescent, dense pneumonic infiltration involving the posteroinferior segment of the right upper lobe. A diagnosis of segmental pneumonia was made. Follow-up roentgenograms on June 10, 18, 21, 24, and July 1, 1948, revealed regression of the infiltration, but a residual process persisted at the last examination (Fig. 1). Because Friedländer's bacilli were found in the sputum it was thought at that time that a Friedländer's pneumonia was responsible for the slow resolution. The patient left the hospital and was advised to return within six weeks.

Contact with the patient was lost until he was re-admitted to the Bayonne Hospital on January 29, 1949. He stated that in the interval between admissions he had had no complaints, gained 10 pounds, and felt generally well. However, a few days prior to the second admission he had a recurrence of high fever, chills, sweats and cough. The patient was acutely ill, running a varying intermittent type of fever, ranging between 99° and 104° F. in spite of relatively

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normal pulse and respiratory rates. There were never any complaints of pain. A blood count on February 1, 1949 showed: hemoglobin, 77 per cent (12 gm.); red blood cell count, 3,740,000; white blood cell count, 5,000; segmented polymorphonuclears, 68 per cent; lymphocytes, 28 per cent; monocytes, 3 per cent; eosinophils, 1 per cent. Sputum examinations on January 31 and February 2, 1949, showed no acid-fast or Friedländer's bacilli.

A Papanicolaou smear of the sputum on February 10, 1949, showed squamous cells, few bronchial cells but no malignant cells. Further roentgenograms taken on February 7, 1949,

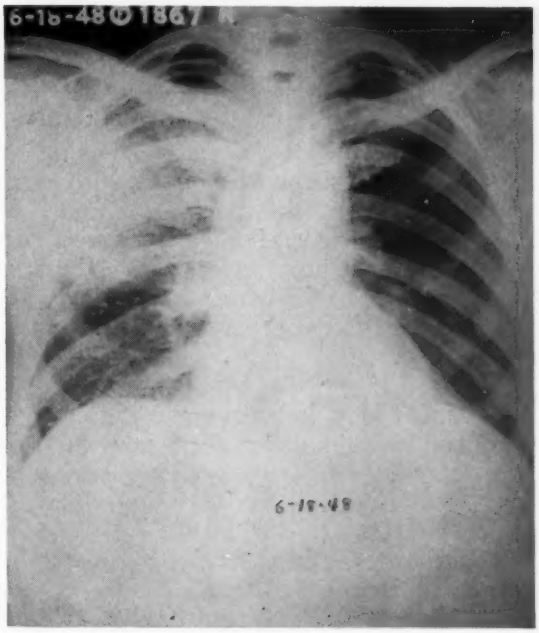

Fig. 1. Case 1.

showed the previously described patchy infiltration of the posterior segment of the right upper lobe more pronounced as compared to the previous examination (Fig. 2). In addition, definite bone involvement of the posterior portion of the right 7th rib was observed. It is of interest that no involvement of the ribs was evident at the previous chest studies. In the posterior axillary line in a circumscribed area measuring about 1 inch in diameter, multiple radiolucencies, surrounded by a slight degree of bone sclerosis, were demonstrated in the bone texture (Fig. 3).

In the roentgenological differential diagnosis the following were considered: (1) bronchogenic malignancy with segmental atelectasis and bone

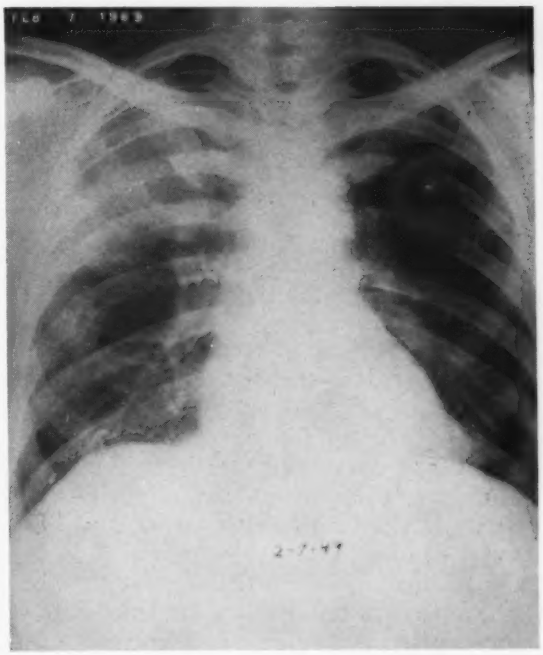

Fig. 2. Case 1.

metastasis; (2) osteomyelitis of the rib following Friedländer's infection of lung; (3) a granulomatous process such as actinomycosis or blastomycosis. Absence of localized tenderness and soft tissue evidence of inflammation militated against a diagnosis of an inflammatory process.

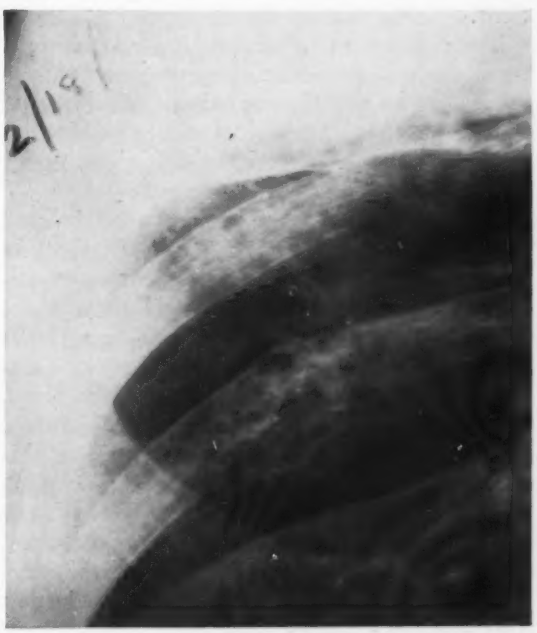

Fig. 3. Case 1.

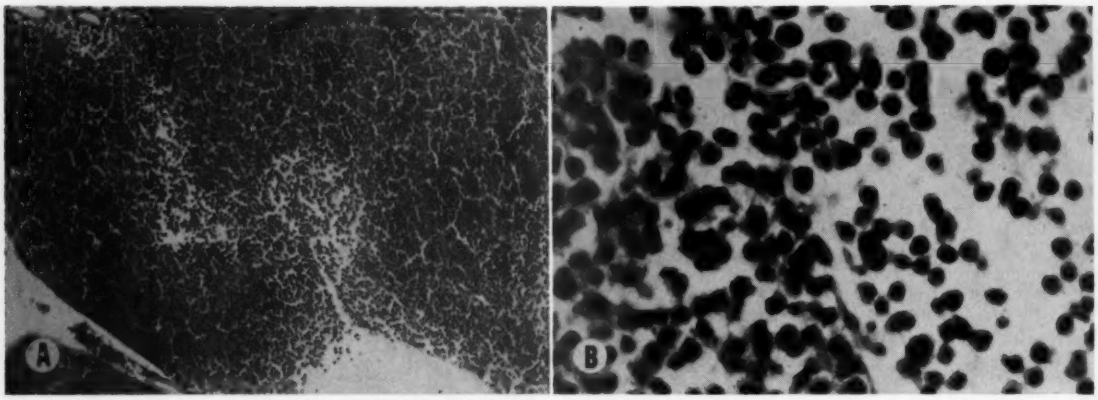

FIG. 4, *A* and *B*. Case I.

In order to make a histopathological diagnosis, a rib resection was performed on March 3, 1949, and the pathologist reported "a diffuse growth of round cells having plasma cell characteristics; mitosis is infrequent but there are both immature cells with a tendency toward mature plasma cell differentiation throughout; the stroma is scant; diagnosis: plasma cell myeloma" (Fig. 4*A* and *B*).

Because of this pathological report further skeletal studies were made, but no roentgenological evidence of other bone involvement was found. Laboratory findings were: Bence-Jones protein, negative; total blood protein and A:G ratio, within normal limits; no hypercalcemia present. Bronchoscopy was refused by the patient.

The patient was treated by antibiotics—aureomycin and penicillin. Improvement was so great that he was discharged symptom-free on March 12, 1949, but with a persistence of residual segmental atelectasis in the right upper lobe.

On May 10, 1949, the patient was admitted to the Pollak Hospital for Chest Diseases in Jersey City, New Jersey, where roentgen examinations disclosed multiple rarefied areas in the ribs, frontal bones and petrous portion of the temporal bone of the skull. There were also suspicious areas of rarefaction in the right ilium. Bone marrow studies were attempted but were not satisfactory. The laboratory findings at this time were the following: serum albumin 3.08, serum globulin 11.2, with an A:G ratio of 1:3.7; Bence-Jones protein in urine, negative; blood count, blood sugar, and blood urea within normal limits. The patient was discharged from this hospital on May 25, 1949, in care of his private physician, who reported his follow-up course to be retrogressive, the patient becoming weaker and losing appetite and weight.

Further roentgenograms were taken on October 20, 1949, which showed destructive processes involving the 1st, 3rd and 4th lumbar vertebrae and multiple punched-out rarefied areas in the ribs, giving the typical appearance of multiple myeloma. The infiltration in the upper lobe of the right lung persisted. In February, 1950, he sailed to his native Spain where, according to a report from the family, he died one month later.

CASE II. The patient was a male, aged sixty-nine, who was admitted to the Somerville Hospital, Somerville, New Jersey, complaining of pain in the right side of the chest, cough and slight expectoration. Because of the presence of a suspicious lesion in the right upper lung he was admitted to the Memorial Hospital, New York City, on March 24, 1949, on the service of Dr. John L. Pool.

Preoperative studies revealed a vigorous, healthy man in good general condition. Roentgenograms showed a mass involving the upper lobe of the right lung (Fig. 5 and 6). Bronchoscopic examination showed some deviation of the entrance to the right upper lobe bronchus without evidence of intraluminal cancer. Examinations of the sputum and bronchial washings by Papanicolaou smears were not conclusive for carcinoma cells. The other significant finding was a venous pressure in the left upper arm of 220 mm. of water without abnormal vital capacity or circulation time.

On April 7, 1949, a right exploratory thoracotomy was carried out. Aspiration biopsy of the right upper lobe mass was returned showing an anaplastic carcinoma. A right pneumonec-

tomy was then performed. The tumor was compressing the superior vena cava but not infiltrating its wall. There was, however, some infiltration in the anterior mediastinum adjacent to the lymph nodes which were removed en bloc with the lung. Postoperative course was uneventful except for a severe, persistent secondary anemia which did not seem readily corrected by multiple transfusions.

On April 12, 1949, venous pressure in the left upper arm was 64 mm. of water. The patient was discharged taking iron and vitamins and was to receive postoperative roentgen therapy to the superior mediastinum. The final pathological report was plasmocytoma of the lung. Sternal marrow aspiration and skeletal roentgenograms showed no evidence of generalized multiple myeloma.

On May 5, 1949, a course of roentgen therapy was completed amounting to 350 r Tiw×10 at 1,000 kv. for a total of 3,500 r applied to the anterior chest.

On July 18, 1949, the patient was seen at the office of Dr. Pool complaining of pain in the right shoulder girdle region and refusing to use his right upper arm. On examination there was tenderness over the posterior third of the operative scar as well as pain following passive elevation of the shoulder and arm. Roentgenoscopy and roentgenography of the chest revealed a clear left lung with the mediastinum in the midline. Stereoscopic Bucky films of the right shoulder girdle region, which are only fair technically did not reveal any bone destruction but showed regeneration of the 5th rib and union of bone to the neck of the 4th rib posteriorly. There was some spotting in the scapula and humerus, probably due to atrophy disuse.

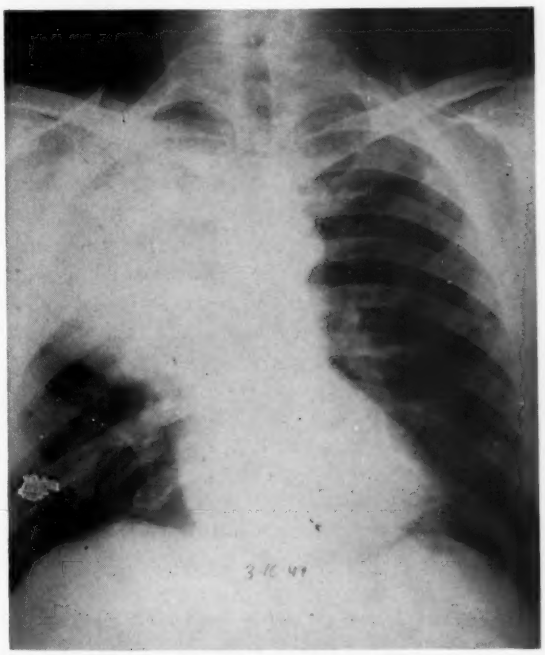

Fig. 5. Case II.

Fig. 6. Case II.

On October 10, 1949, the patient felt better and was using his right arm considerably more but still was unable to raise it more than 70°. Examination showed no evidence of recurrence of the lesion. Roentgenoscopy was negative.

On December 19, 1949, a specimen of sputum examined by Dr. Papanicolaou was reported as negative. On January 21, 1950, the patient had no complaints.

Physical examination was not remarkable. The right shoulder was not tender. The blood showed a hemoglobin of 80 per cent, and red blood cell count of 4,850,000. Roentgenogram of the chest was satisfactory. On April 22, 1950, the only complaint was slight pain in the right side of chest during rainy weather. On August 26, 1950, the hemoglobin was 88 per cent while taking hematinic medication. He continued to have some discomfort in his right chest with trigger tenderness over an area measuring 2 cm. in diameter just below and anterior to the thoracotomy scar. This was injected with 2 per

cent novocain solution. No signs of recurrence or generalization have appeared since the operation.

SUMMARY

Two cases of extramedullary pulmonary plasmocytoma have been presented. In the first case a correct diagnosis was not made until spread to the bones had taken place, resulting in the death of the patient with generalized multiple myeloma. In the second case a correct diagnosis was made while the lesion was still localized in the lung, permitting lobectomy to be performed and, up to the present time, preventing a spread of the disease with ultimate death.

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We are deeply indebted to Dr. Nicholas G. Demy of Plainfield, New Jersey and Dr. John L. Pool of New York City for their kindness in permitting us to present Case II in this article.

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Vol. 70, No. 6

LEFT-SIDED GALLBLADDER

NECESSITY FOR FILM OF THE ENTIRE ABDOMEN IN CHOLECYSTOGRAPHY*

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THERE is a paucity of reports in the literature on the occurrence of left-sided gallbladder, so that its incidence can be seen to be rather low in cases without complete visceral situs transversus. Bleich, Hamblin and Martin[2] reviewed the literature on this subject and found 11 previously reported cases, to which the addition of their case made a total of 12, and the fourth found preoperatively by roentgen examination. The inclusion of the cases reported by Drechsel[3] and McGowan, Nussbaum and Burroughs[4] not included in Bleich's bibliography brings the previous total to 14 cases. Addition of these 2 cases gives a total of 16 and makes the sixth found preoperatively. When this anatomical variant does occur, however infrequently, it can be of great importance to the roentgenologist, to the surgeon and to the patient because of the danger of misinterpreting failure to see a gallbladder shadow in the right side of the abdomen after ingestion of contrast medium as evidence of a diseased or nonfunctioning gallbladder. In the report of McGowan *et al.*[4] of cholecystitis due to *Giardia lamblia* in a left-sided gallbladder, the cholecystogram was reported as showing no evidence of filling of the gallbladder. At operation the fundus of the gallbladder was found under the left lobe of the liver, the neck crossing the posterior portion of the longitudinal fissure where the cystic duct joined the common duct on the right side. No calculi were found but scrapings of the gallbladder wall mucosa revealed *Giardia* cysts and some evidence of ulceration extending to the submucosa. Cholecystectomy was performed. A personal communication with the surgeon and the radiologist, who were working in an Army hospital at the time, indicates that only 10 by 12 inch conventional films were made so that the possibility of filling of the left-sided gallbladder could not be excluded.

CASE REPORTS

CASE 1. The first case reported is of a male, aged forty-two, who had complaints of flatulence and upper abdominal discomfort associated

FIG. 1. Case 1. Posteroanterior view of entire abdomen showing excellent concentration of contrast medium in a gallbladder of normal size and shape, but ectopically placed between the transverse processes of the 3rd and 4th lumbar vertebrae on the left side of the vertebral column. There is no evidence of radiolucent calculi. The gallbladder emptied normally after the fat meal.

* Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the author are the results of his own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

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FIG. 2. Case I. Left posterior oblique position with reference to tube, showing the gallbladder located well to the left side of the vertebral column between the transverse processes of the 3rd and 4th lumbar vertebrae.

FIG. 3. Case I. Left posterior oblique position with reference to tube, showing the gallbladder placed ectopically in relation to the duodenal loop, and lying in the left side of the abdomen.

with meals for several years. He also had chronic pulmonary tuberculosis, moderately advanced and inactive at this time. An upper gastrointestinal examination revealed no evidence of organic disease in the stomach, duodenum or small intestine. The colon was likewise normal. A plain 14 by 17 inch film of the abdomen was normal. A cholecystogram was made fifteen hours after ingestion of six tablets of priodax and the usual 10 by 12 inch films of the right side of the abdomen were made. The gallbladder was not visualized on any of these films and a report of nonfunctioning gallbladder rendered with the inference that we were dealing with a diseased organ. A re-examination was ordered and a 14 by 17 inch film of the whole abdomen was exposed sixteen hours after ingestion of priodax to be sure of locating the gallbladder if any contrast medium were concentrated. In this film the gallbladder was plainly seen on the left side of the vertebral column below the level of the transverse process of the third lumbar vertebra (Fig. 1). This position was constant on all views and slightly accentuated in the left posterior oblique position, with reference to the tube, to project it away from

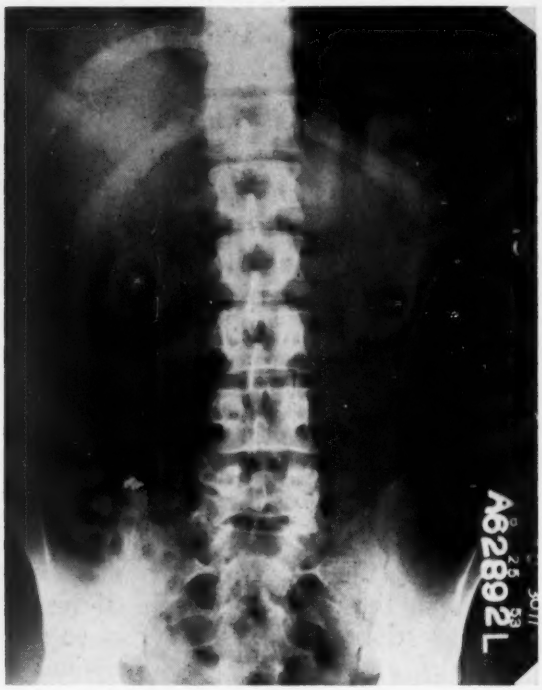

FIG. 4. Case II. Gallbladder on left side of vertebral column as revealed on roentgenogram of entire abdomen.

the spine (Fig. 2). Re-examination of our original 10 by 12 inch films on this patient showed no evidence of the gallbladder as none of the films extended to the left side of the vertebral column.

After locating the organ, as above described, a little barium was given and it was found that the stomach and duodenal loop occupied a position almost entirely to the left side of the vertebral column and that the ectopically

Fig. 5. Case II. Left posterior oblique position, erect, to displace gallbladder entirely free from spine.

placed gallbladder lay posterior to the ascending duodenal loop in the left side of the abdomen (Fig. 3).

Case II. The second case is that of a twenty-eight year old veteran of World War II who, while on active duty in Italy during 1944, developed loss of appetite and had nausea and vomiting associated with pain in the upper abdomen, accompanied by yellow discoloration of the skin and eyes. He was hospitalized for almost a year for this condition which was diagnosed as hepatitis. Since his discharge from the service he has had recurrent loss of appetite, nausea and pain in the abdomen but without development of icterus.

The patient was examined at this time because of recurrent vague pains in the abdomen associated with gas and indigestion, and survey roentgenograms of the abdomen followed by a cholecystogram were made. The gallbladder was not visualized on the first 10 by 12 inch film of the right side of the abdomen. A second 14 by 17 inch film revealed the viscus on the left side of the vertebral column (Fig. 4) adjacent to the stomach. A further examination by rotating the patient into the left posterior oblique position (Fig. 5) in the direction opposite to the one usually employed to displace the gallbladder shadow from the vertebral column clearly showed the organ in both prone and erect projections. Its appearance indicated a normally functioning gallbladder without calculi.

Similar symptoms to those reported above were described by Bleich's patient.[2] The patient of Biancheri[1] had tenderness on palpation between the ensiform process and the umbilicus, but probably this was due to a prepyloric gastric ulcer demonstrated on other examinations. The left-sided gallbladder in Biancheri's patient exhibited normal physiological function and no calculi were demonstrated. Since no definitely pathological left-sided gallbladders, except the case of McGowan's described above,[4] have been reported to date, it is difficult to say just what symptoms, if any, would be characteristic of such aberrant position.

It is quite usual to see plain survey films of the abdomen of the 14 by 17 inch size, made to exclude possibility of radiopaque calculi in the urinary or biliary tracts before administration of opaque media. Most roentgenologists, however, use 10 by 12 inch films routinely covering the right side of the abdomen to locate the gallbladder during cholecystography, after which smaller films are used for further, more detailed study. When there is no evidence of any concentration of contrast medium in the gallbladder this is taken as indicative of a nonfunctioning or diseased viscus. Repeat examinations with 10 by 12 inch films or double doses of contrast medium frequently ordered will not obviate this difficulty when we are dealing with a left-sided organ. In view of this

experience, it seems that before making a diagnosis of failure of the gallbladder to visualize after ingestion of contrast medium, it is desirable that a film of the entire abdomen be exposed to exclude the possibility of a left-sided or ectopic gallbladder.

Stevenson[5] recently reported on the importance of identifying soft tissue shadows in the abdomen on a survey roentgenogram before opacification of the gallbladder in order to determine its relation to the edge of the liver, the hepatic flexure of the colon and the descending limb of the duodenum, and also to be sure that a soft tissue shadow of the gallbladder may not be shown to the left of the vertebral column.

SUMMARY

A left-sided gallbladder may occasionally be missed if only conventional 10 by 12 inch films are exposed of the right side of the abdomen during cholecystography. In such cases an erroneous report of nonfunctioning, presumably diseased gallbladder may be made even after a double dose of contrast medium on repeat examination. To avoid this error, it is suggested that a 14 by 17 inch film of the abdomen be used in cholecystography when the gallbladder is not visualized on a 10 by 12 inch film.

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VOL. 70, No. 6

SOME RADIOTHERAPEUTIC ASPECTS OF GLANDULAR CUTANEOUS CANCER*

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A VOLUMINOUS literature has developed during this century dealing with the effectiveness of radiation as well as surgical treatment of cancer in the human integument. First, as to the radiation treatment, it is obvious that the majority of the cases can be permanently cured. This circumstance, also, partly accounts for the well recognized fact that comparatively few patients die of skin cancer. Second, cutaneous carcinomas respond in about the same way to irradiation regardless of their microscopic structure; this means that the histopathology of the lesion would not be any direct criterion for the choice of treatment, provided the treatment was adequate, the therapy carried out under similar circumstances, and all the radiation factors were in correct relation to each other.[1,3,5,6,11,20,21,22,23,27,36] The tumors must be small and superficial; the size and extent of a carcinoma are the most important factors in estimating its radiocurability; carcinomas which infiltrate underlying structures show considerably poorer cure rates than do the superficial ones.[21]

Even though the radiation treatment has been correct—paying proper attention to the due factors—we, however, sometimes encounter cases among skin carcinomas which do not react favorably to the primary irradiation. Often the cause of the apparent failure may be explained. Radiotherapists are acquainted with them, and almost all of the most important reasons influencing in some way or other the failures, have, in general, been discussed in the literature. There would not be much to add to these from the "clinical" point of view. The fact is that human beings can also die of primary skin cancer.

However, at the risk of being prosaic, the writer would like to present some additional aspects on the radiation treatment of certain types of skin carcinomas. He has, in another connection, reported observations[29,31] indicating the existence of certain peculiar primary cutaneous carcinomas which in many respects differ from the so-called actual integumental ones: namely, carcinomas with sebaceous and/or sudoriferous structures. On the one hand, there is in the literature comparatively little to be found on the effectiveness of radiation and surgical treatment of these tumors. On the other hand, certain highly differentiated skin carcinomas containing sebaceous structures as well as those containing simultaneously both sebaceous and sudoriferous structures, and when growing in a highly malignant manner, can possess properties, both microscopically and clinically, resembling those seen in cancer of the mammary glands, *i.e.*, modified apocrine sweat glands. Interesting are all the skin carcinomas which contain highly differentiated sebaceous elements; in these, the paradoxical situation exists that a part of the tumor tissue tends to "secrete" itself (according to the holocrine mode of function) whereas, at the same time, the cancerous growth progresses.

MATERIAL

The material investigated comprised 33 of our own cases, belonging microscopically to three main groups (Table 1).

The microscopic make-up, the mode of growth and dissemination, the clinical picture and the general development of the disease have been presented elsewhere in detail. The following may, however, be said:

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In general, carcinomas derived from dermal glands have been comparatively rare, as reported in the literature.[9,10,17,31,34,38] Gates, Warren and Warvi,[9] and Warren and Warvi,[38] for instance, found only 29 cases of sebaceous and 6 of sudoriferous carcinomas among some 4,000 cutaneous malignant lesions examined by them. Parreira[25] reported the incidence of sebaceous carcinomas as high as 4.6 per cent of all cutaneous carcinomas. Stout[34] found 21 sudoriferous, but only 2 sebaceous carcinomas among 937 skin cancer cases. At the Radiumhemmet, in 2,358 cutaneous carcinomas, diagnosed during the years 1936 to 1947, there were 18 of sebaceous origin.

There are two different types of dermal gland carcinomas:[31] (1) Carcinomas in which the microscopic architecture and mode of growth as well as the general course of the disease resemble those seen in actual epidermal cancer. These tumors react to treatment in about the same way as other skin carcinomas in general. (2) Carcinomas—being, however, quite uncommon—in which the corresponding properties resemble those sometimes seen in cancer of the mammary glands. These properties are: the microscopic make-up, the general development of the disease, superficial mode of dissemination ("cancer en cuirasse" type), intraepidermal proliferation indistinguishable from that in Paget's disease of the nipple, a histologic mode of secretion being intermediate between the holocrine type of sebaceous glands and the apocrine type of mammary glands, and a certain tendency to form both regional and distant metastases.

TABLE I

Group	Microscopic Diagnosis	No. of Cases	Total
I	Sebaceous carcinomas	1–23	23
II	Sudoriferous carcinomas	25–29	5
III	Carcinomas containing both of these structures	24, and 30–33	5

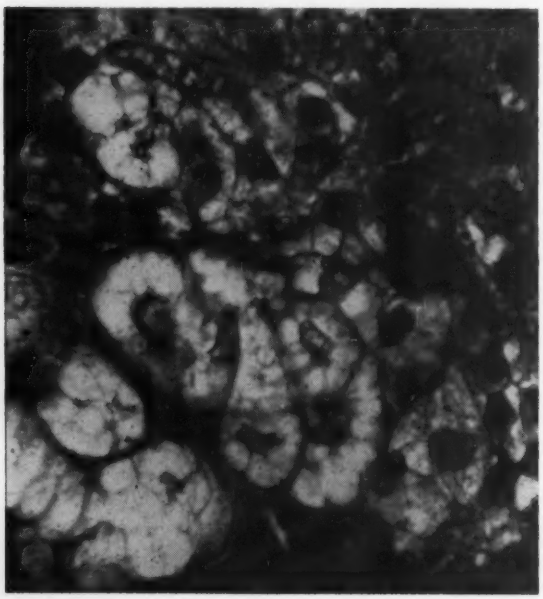

FIG. 1. Case 1 (No. 1213–1936). Highly differentiated (mature) sebaceous cells. Sebaceous carcinoma with basal cell carcinoma architecture. Masson's trichrome stain.

There exist several intermediate forms between the sebaceous and the sudoriferous carcinomas. The undifferentiated cytoplasmic cells in sebaceous as well as in carcinomas with both glandular structures seem to act as the so-called germinative cells in normal sebaceous glands (Fig. 1, Case 1). The inherent properties influence to a certain extent the general appearance of the dermal gland carcinomas. They show microscopically "epidermal" properties (mode of growth, pearl formations, keratinization).

There are several types of sebaceous cells in these carcinomas: sometimes the cells closely resemble those in normal sebaceous glands; sometimes they tend to form "saccule-thromb" vegetations, composed of sebaceous cells with a nucleus flattened against the cell wall and confluent fat-droplets to form larger balls; sometimes they are pale, of an acanthotic type without spongioplasm. The more the cytoplasmic cells have the microscopic appearance of the corresponding structures in actual basal cell (Cases 1–6), basosquamous (Cases 7–16), but especially in squamous cell carcinomas (Cases 17–23), the fewer highly differentiated (Fig. 1) and

the more poorly differentiated sebaceous cells were encountered.

A peculiar mode of microscopic appearance was shown in cases with highly malignant course (Cases 12, 24, 31, and 33): there were "saccule-thromb" vegetations (Fig. 2 and 4*A*, Case 12) which gave the general character to the microscopic make-up. These vegetations could also permeate along blood and lymph vessels (Fig. 2, Case 12). They were also encountered, for instance, in pulmonary lymph node metastases at autopsy (Case 12).

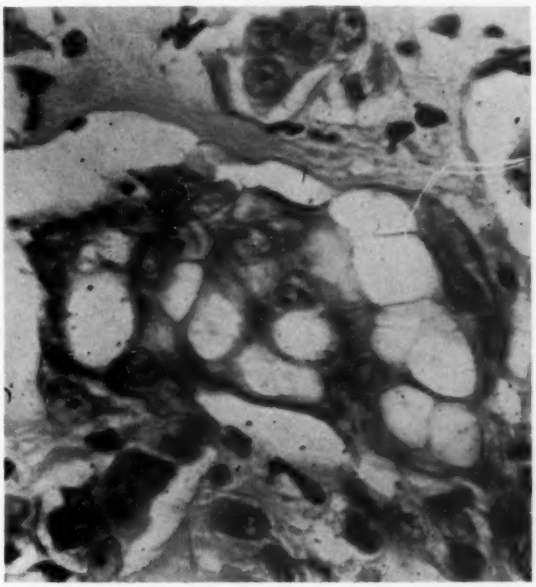

Fig. 2. Case 12 (No. 1845–1938). "Saccule-thromb" vegetation growing in subpapillary vessels. Great vacuolated sebaceous cells with nuclei flattened against the cell wall. Masson's trichrome stain.

Another peculiar mode of appearance was that of superficial dissemination. This gave the clinical picture of "cancer en cuirasse" appearance (Fig. 12, Case 12, and Fig. 14 and 15, Case 33).

Especially in Case 12 there was intraepidermal proliferation indistinguishable from that in Paget's disease. It is also interesting to note in this connection that several workers[14,18,26,30,39] have presented the opinion that Paget's disease of the nipple, and especially so-called extramammary Paget's disease, must have something to do, on the one hand, with the mammary glands (or with their carcinomas), and on the other, with some actual dermal glands (or with their carcinomas). Figure 4, *B* and *C*, will illustrate the intraepidermal occurrence in sebaceous carcinoma (Case 12).

TREATMENT

Surgery (simple excision, extirpation, electrocoagulation) was used in 13 cases as treatment for the primary or the recurrent tumors in which no preceding irradiation had been given.

In the others, irradiation (or combined radiation and surgical treatment) was employed. Irradiation was carried out according to the general principles being used at the Radiumhemmet.[1,3,6,13,19,35,36] In general, these glandular carcinomas were treated as ordinary skin carcinomas. Sometimes, however, when the tumor on microscopic examination proved to deviate from "normal," the regional lymph nodes were prophylactically treated.

When evaluating the effectiveness of irradiation in the present material, Strandqvist's[36] method was used in cases where its employment was possible.

RESULTS

In the following some illustrative cases are presented. After these a short survey is given of cases in which nothing unusual was observed.

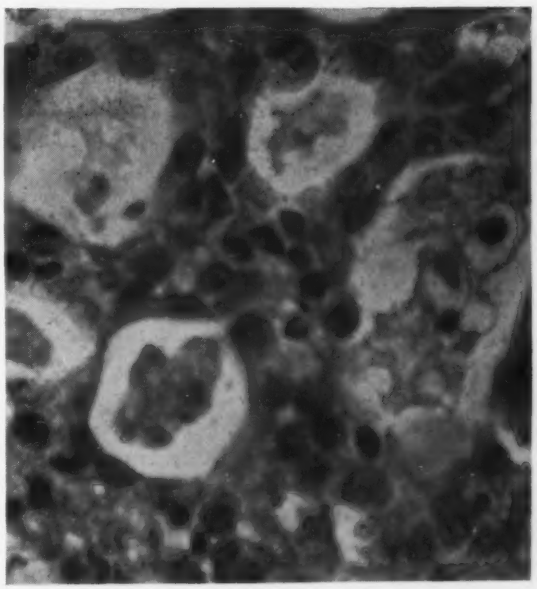

Fig. 3. Case 24 (No. 1036–1931). Cutaneous carcinoma containing simultaneously both sebaceous and sudoriferous structures. Holocrine mode of secretion.

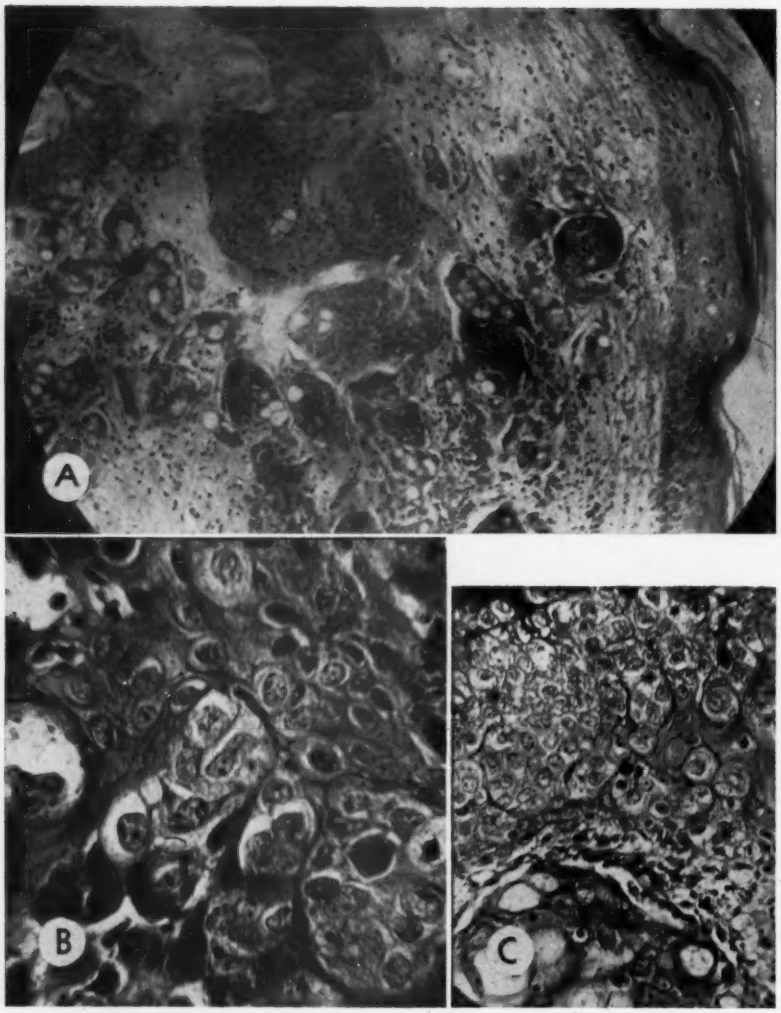

Fig. 4. (*A*) Case 12 (No. 1596-1938). Cancer vegetations growing underneath the epidermis. Saccule-thromb formations growing in all layers of the corium. Hematoxylin-Van Gieson. (*B*) Case 12 (No. 1596-1938). Intraepidermal proliferation resembling Paget's disease of the nipple. (*C*) Case 12. Intraepidermal proliferation. Beneath the epidermis saccule-thromb vegetations. Masson's trichrome stain.

Recording of cases is the same as previously used.[31]

Case 17. Female, aged fifty, admitted July 18, 1940. She has had a slowly growing cutaneous change postauricularly on the right side for several years.

Physical Examination (Fig. 6). An ulcerated, easily bleeding tumor situated postauricularly. The lesion was not movable against the underlying structures. Clinically malignant.

Microscopic Examination (No. 1273-1940). Cutaneous carcinoma with sebaceous structures; the majority of the sebaceous cells were poorly differentiated. The mode of growth and the general architecture resembled that of squamous cell carcinoma.

Treatment. July 19 to 27, 1940. Roentgen irradiation. Factors: 7×700 r, and 1×500 r over the lesion itself; 7×700 r over the skin around the tumor, 145 to 171 kv., 5 to 10 ma., area 36 sq. cm., target skin distance 30 cm., filter 0.5 mm. Cu plus 1 mm. Al. July 31, 1940, the tumor has decreased in size.

Follow-Up Information. September 3, 1940, the lesion has further decreased in size. October 3, 1941, superficial skin necrosis (apparently irradiation injury) (Fig. 7). January 25, 1946, healed, but atrophic skin in the treated area. October 24, 1947, condition unchanged. Obser-

vation over a period of about seven years does not show any evidence of recurrence (local skin necrosis).

Case 22. Female, aged sixty-one, admitted February 27, 1942. Shortly before December 25, 1941, she observed a change in the skin on the right side of the upper lip.

Physical Examination (Fig. 8). On the vermilion border there was a firm tumor about the size of a nut. The main portion of the lesion was localized intracutaneously, infiltrating the upper lip about 5 mm. Clinically malignant.

Microscopic Examination (No. 388-1941). Cutaneous carcinoma with sebaceous structures. Almost all of the sebaceous cells were poorly differentiated; only a few were highly differentiated. Whorl formations. The mode of growth and the general architecture resembled that of squamous cell carcinoma.

Fig. 5. Case 33 (No. 16–1941). Cancerous growth permeating along the subcutaneous vessels. Clinically "cancer en cuirasse" mode of growth.

Treatment. February 27 to March 6, 1942. Roentgen irradiation. Factors: 6×700 r, and 1×400 r, 165 to 186 kv., 15 to 30 ma., target skin distance 30 to 40 cm., area 5 sq. cm., filter Sn. March 6, 1942, the lesion has clearly decreased in size.

Follow-Up Information. April 8, 1942. The lesion has further decreased in size. Observation over a period of about five years does not show any evidence of recurrence.

Fig. 6. Case 17 (No. 1273–1940). Cutaneous carcinoma with sebaceous structures, before treatment, July 18, 1940.

Case 32. Female, aged fifty-nine, admitted October 29, 1937. She has had, very likely since birth, in the parietal region a reddish, easily bleeding nodule, covered by skin. She claimed to have hurt it three to four years ago, after which it began to grow rapidly. A year ago it bled abundantly after trauma; then it grew to its present size.

Fig. 7. Case 17. October 3, 1941. Superficial (irradiation) necrosis. The tumor is healed.

FIG. 8. Case 22 (No. 388–1941). Cutaneous carcinoma with sebaceous structures, before treatment, February 27, 1942.

Physical Examination (Fig. 10). An irregular, lobulated tumor, 6 to 4.5 cm. in size appeared to be in the parietal region, not adherent to the underlying structures. Clinically malignant.

Microscopic Examination (No. 1382-1937). Cutaneous carcinoma with sebaceous and sudoriferous structures, the mode of growth and the general histopathologic architecture varying in different parts of the lesion, containing at the same time basosquamous carcinoma-like components. The various glandular components were highly differentiated.

Treatment. November 4, 1937. Surgical removal (Fig. 11). Microscopic examination revealed that the extirpation was adequate.

Follow-Up Information. Observation over a period of about nine and a half years does not show any evidence of recurrence.

CASE 12. Male, aged sixty-seven, admitted September 21, 1938. Two years before hospitalization he happened to scratch a brown, porous "birthmark" of the skin on the left side of the back. About a month later numerous, small nonpainful nodules appeared in the neighborhood of the primary lesion, spreading rapidly in the vicinity of the first tumor; new nodules have appeared continuously.

FIG. 9. Case 22. Condition on April 8, 1942. The lesion has decreased in size.

Physical Examination (Fig. 12). The examination revealed a great number of several kinds of malignant cutaneous lesions, arranged in a zoster-like band and stretching to the left hip and, anteriorly, to the mammillary line. On the posterior aspect, the lesion was sharply bounded to the middle line. Clinically the condition resembled "cancer en cuirasse." Two hard, large and partly fixed lymph node metastases were palpable in the left and a similar one in the right axilla. Clinically, "very superficially spreading basal cell carcinoma."

FIG. 10. Case 32 (No. 1382–1937). A reddish, easily bleeding tumor. Condition before treatment, October 29, 1937.

Microscopic Examination (Fig. 2, 4, *A*, *B* and *C*) (No. 1532-, 1596-, 1733-, 1845-1938, and 415-, 508-, 935-1939). The cancerous growth was composed of an enormous number of vegetations containing different types of elements, infiltrating all layers of the subcutaneous structures as well as tissue spaces and permeating along lymph and blood vessels (Fig. 2). (1) The first type of cells were cytoplasmic, resembling somewhat those in basosquamous carcinoma. A great number of these were in various phases of division. (2) The cells of the second type appeared pale, the nuclei were often clumped, and sometimes they had a nearly normal appear-

ance, sometimes again they were hyperchromatic. No mitotic figures were encountered in these cells. The spongioplasm could not be distinguished. (3) The third type of cells gave a peculiar microscopic appearance, showing formation of saccule-thromb vegetations. The cells in these vegetations were partly undifferentiated cytoplasmic cells, partly sebaceous cells with a nucleus flattened against the cell wall and confluent fat-droplets forming greater balls (Fig. 2 and 4, *C*).

The intraepidermal proliferation resembled closely that seen in Paget's disease of the nipple; the cells also tended to form saccule-thromb vegetations (Fig. 4, *B* and *C*).

Treatment. October 3 to 24, 1938. Roentgen

Fig. 11. Case 32. Condition on December 4, 1937, after surgery. No evident dissemination.

irradiation. Factors: 5×400 r, 105 to 108 kv., 12 ma., target skin distance 100 cm., areas 400 and 500 sq. cm., filter 1 mm. Al. During the treatment the disease progressed and spread over the middle line to the right side of the thoracic wall. Because the irradiation areas partly overlapped each field received about 3,100 r. October 22, 1938. The individual lesions had become restricted, and were now more clearly in a segmental arrangement. October 31, 1938. The small individual nodules in the skin have become less conspicuous and some of them have even disappeared. The disease progressed continuously (Fig. 13). March 23, 1939. Low voltage short distance irradiation. Factors: dose 3,500 r, 40 kv., 2 ma., target skin distance 1.8 cm., diameter of the irradiation field 7, 10 and 12 mm. respectively. Altogether 83 different

Fig. 12. Case 12. (Cf. Fig. 2 and 4.) Sebaceous carcinoma with saccule-thromb vegetations. Clinically "cancer en cuirasse" type of appearance.

areas were treated. April 11, 1939. The infiltrations treated had, in all irradiation fields, diminished in size. May 21, 1939. Roentgen irradiation to the metastases (right axilla 2,400 r, left axilla 2,000 r).

Follow-Up Information. The patient died of general carcinosis in September, 1939. The postmortem examination revealed a great number of regional and distant metastases (also pulmonary metastases). The cancerous tissue was microscopically like that in the primary tumor.

Case 33. Male, aged fifty-nine, admitted January 4, 1941. He has always had a small "birthmark" on the frontal aspect of the left thigh. A year before hospitalization the lesion began to grow, and there developed numerous small papules, spreading slowly at the beginning, but during the last two or three months to such an extent that the cutaneous lesions involved the skin of the whole left upper thigh. Simultaneously progressive edema of the left lower limb developed.

Physical Examination (Fig. 14 and 15). The left lower limb had an elephantiasis-like appearance, the edema reaching anteriorly to the lower abdomen, including the external genitalia.

FIG. 13. Case 12. Condition after the first treatment series, October 30, 1938. Some of the treated papules and plaques are reduced in size, several others—again—have developed. Rapid progression of the disease.

The integument presented numerous small plaques and papules, arranged zoster-like; some of them were fixed to the skin, others again to the underlying structures. Clinically malignant.

Microscopic Examination (No. 16-1941). The tumor contained a large number of epithelial cell islands of varying size and shape, infiltrating all layers of the cutis as well as part of the overlying epidermis. There were dilated vessels filled with cancerous growth (Fig. 5).

The first portion of the cancerous tissue resembled the picture described earlier in connection with Case 12, showing saccule-thromb vegetations. The second portion resembled closely, in general histopathologic architecture and mode of growth, that of sweat gland adenocarcinoma. In this portion of the cancerous growth there were also highly differentiated sebaceous cells, sometimes solitarily situated, sometimes arranged in groups. The part composed of sudoriferous elements also permeated along blood and lymph vessels.

Treatment. January 9 to 24, 1941. Roentgen irradiation. Factors: 7×400 r, two fields: front and back, 145 kv., 14 to 15 ma., area 300 and 400 sq. cm. respectively, target skin distance 100 cm., filter 4 mm. Al. February 10, 1941 (Fig. 16). The individual small tumors have diminished considerably in size. February 27, 1941 (Fig. 17). Some of the tumors have disappeared. Telecurie treatment to metastases. Factors: 2 areas, 3×900 r to each, 3 gram unit. April 29, 1941 (Fig. 18). Further progression of the cancerous growth. April 13–June 7, 1941. Roentgen irradiation to the knee region (5×700 r), to the hip region (7×400 r), to inner surface of the thigh (4×400 r). Other factors: 102 to 145 kv., 12 to 14 ma., area 75, 200 and 200 sq. cm. respectively, target skin distance 30, 30 and 60 cm. respectively, filter 1 to 4 mm. Al. At the same time telecurie treatment was given to the

FIG. 14. Case 33 (No. 16-1941, cf. also Fig. 5). Cutaneous carcinoma with simultaneously both sebaceous and sudoriferous, highly differentiated structures. "Cancer en cuirasse" type of appearance.

left groin (2 fields, 1,800 r to each). August 6, 1941 (Fig. 19). Cancerous growth somewhat regressed. November 7, 1941. General dissemination. No further treatment.

Follow-Up Information. The patient died on March 1, 1942 (general carcinosis).

In the following a short survey of the effectiveness of radiation and surgical treatment (primary tumors, first treatment) will be given (see Table II).

Surgical Treatment. As primary treatment, surgical measures (simple excision, ordinary extirpation, electrocoagulation) were used altogether in 13 cases. Because the surgery in 5 cases was performed in other hospitals, it is unknown whether malignancy of the tumors was suspected before operation. Of the 13 cases, 10 developed local recurrence and 4 metastasized. The primary carcinoma was healed in 3 cases: Case 27 (sudoriferous carcinoma) died of intercurrent disease after one year (eighty-three years old); Case 29 (sudoriferous carcinoma) and Case 32 (carcinoma with sebaceous and sudoriferous structures) are living after two, and nine and a half years respectively. One case (Case 24, carcinoma with sebaceous and sudoriferous structures) died with general carcinosis. Of the recurrent tumors 2 were treated surgically; living after three years. The others were treated radiologically. One died of intercurrent disease six months after irradiation. The others are living and symptomless after three to nine and one-half years.

Fig. 15. Case 33. Condition on admission. Frontal aspect.

Fig. 16. Case 33. Condition on February 10, 1941.

Radiation Treatment.

(1) Radium implantation was used in 7 cases of primary carcinoma, and in 2 cases of recurrent carcinoma. The number of

FIG. 17. Case 33. Condition on February 27, 1941.

needles (the whole length of needles 1.5 cm., active length 0.8 cm., wall of 0.2 mm. Al and 0.3 mm. Pt, equivalent to 0.9 mm. Pb), as well as the duration of interstitial irradiation, depended on the size of the tumor. Of these, 7 have been symptomless for two to six years, 2 have died (also symptomless) after one-half and three years respectively of intercurrent disease.

(2) Telecurie treatment was given once (Case 5): during eighteen days 5,060 r was administered (3 gram unit). The patient is symptomless after two and one-half years.

(3) Low voltage, short distance irradiation was given in 2 cases of primary tumors, and in 2 cases of recurrent tumors. The cases were symptomless after about two years (cf. Case 12, above).

(4) In all other cases long distance roentgen irradiation was used. The average daily dose was 700 r (sometimes 350 or 400 r), given every day of the week. The total skin dose amounted to 3,500 r, or 4,200 r respectively, 105 to 185 kv., 5 to 30 ma., target skin distance 30 to 40 cm. (and to 100 cm.), filtration (in most cases) 0.5 mm. Cu, sometimes 4 mm. Al, or 0.5 mm. Cu plus 1 mm. Al.

Of the tumors treated primarily with irradiation 5 recurred locally; 2 of these patients died from general carcinosis (related above: Cases 12 and 33). In 3 cases the primary irradiation was inadequate. Four of the treated cases died symptomless (the first immediately, the others after one-

FIG. 18. Case 33. Condition on April 29, 1941. Clear dissemination of the disease preceding death.

Fig. 19. Case 33. The cancerous growth again somewhat regressed.

half, one-half, and three years respectively) from intercurrent disease. The others are living from one to nine years.

DISCUSSION

Comparatively little attention has been paid in the literature to the treatment of carcinomas which can be designated sebaceous and/or sudoriferous. Often the existence of these carcinomas is only mentioned in passing.[21,23,32,33] It is possible—because of the mutability of their elements as well as of their epidermal characteristics—that these malignant tumors have not always been diagnosed correctly but, at least sometimes, they have been confused with basal cell or squamous cell carcinomas and treated as such.

Surgical excision has been the form of treatment most often employed;[2,9,16,17,38] there is little exact information available as to the effectiveness of radium or roentgen irradiation upon these tumors. Beach and Severance,[2] for instance, state that adequate surgical removal of the tumor and regional lymph nodes is the primary method of treatment, while irradiation may be used "when indicated." There are a few papers dealing with this subject.[9,15,25,38] Often, however, the irradiation has been highly inadequate.

As has been mentioned in the first part of this paper, the histopathology of skin cancer would not be any direct criterion as to the choice of treatment, provided the irradiation was "adequate." However, Hintze,[12] after studying the reasons for failure in treatment of cutaneous cancer states that "Cases with unusual structure such as adenomatous or solid carcinomas have proved particularly unfavorable, whereas scirrhous carcinoma did not show a course less favorable than the common skin carcinoma."

The present material contained two main groups of dermal gland cancer: (1) carcinomas in which the microscopic architecture and mode of growth as well as the general development of the disease resembled that of actual epidermal cancer; (2) carcinomas in which the corresponding properties resembled those sometimes seen in cancer of the mammary glands. The first mentioned type seems to be the most common one.

(1) Recurrences and metastases appeared in all (histopathologic) subgroups after treatment. Practically all of the cases treated surgically developed recurrence and/or metastasized. (It is, however, possible that the surgery has not always been radical enough.) Of cases treated primarily with irradiation 3 developed local recurrence.

In Case 4 (sebaceous carcinoma with

TABLE II

Case No.			P.A.D. No.	Local Recurrence(s) after		Metastases	
Sebaceous Structures	Sudoriferous Structures	Both Structures		Surgery	Irradiation	Regional	Distant
1			1213–1936	Yes		—	—
4			234–1941		Yes	Suspected	—
6			79–1939		Yes	—	—
8			1308–1944	Yes		—	—
9			239–1940	Yes		—	—
10			1623–1938	Yes		—	—
12			1532–1938		Yes	Yes	Yes
15			2588–1943	Yes		—	—
19			2030–1940	Yes		Yes	—
23			291–1943	Yes		—	—
	26		502–1938		Yes	—	—
		24	1036–1931	Yes		Yes	Yes
		30	7256–1945	Yes		Yes	Yes
		31	1565–1937	Yes		Yes	—
		33	16–1941		Yes	Yes	Yes

basal cell carcinoma-like general architecture) 2,900 r was given during one day as long distance roentgen irradiation. The tumor recurred locally two years later, and was then surgically removed (symptomless about six years).

In Case 6 (microscopically like Case 4) 4,000 r was given during seven days. The tumor recurred after about six months, and was treated with radium implantation (symptomless about five years).

In Case 26 (sudoriferous carcinoma with basal cell carcinoma-like general architecture) an unknown amount of irradiation was given in another hospital. The recurrent tumor was surgically removed (symptomless about nine years).

In the recurrent tumors the total radiation dose remained below the "necessary" curative amount (as calculated according to Strandqvist[36]). However, since radiation treatment was carried out as in the cases of ordinary skin carcinoma and the patients were cured (symptomless from one to nine years), the conclusion may be drawn that these carcinomas would not be more resistant to irradiation than ordinary skin carcinomas in general. On the other hand, no conclusions can be drawn as to whether these tumors would be more sensitive to irradiation than the actual skin carcinomas.*

(2) Cutaneous carcinomas having properties in common with carcinomas of the mammary glands reacted unfavorably to the irradiation. Three of these (Cases 12, 24, and 33) terminated fatally and the patients died with general carcinosis arising from the primary lesion. What, then, were the causes of failure of treatment in these cases? Evaluation of the reasons is not easy. The following may, however, be said. For the most part, the disease was far advanced when the patients came for treatment; there were metastases in the regional lymph nodes, a superficial ("cancer en cuirasse") dissemination of the lesion (Fig. 12, 14 and 15), progressive edema, etc. As seen in the literature, cutaneous metastases are rare with the exception of carcinoma of the mammary glands (similar signs may, however, also appear in cases of carcinoma of the stomach, uterus, lungs, large intestine and kidneys, prostate and ovaries).

* From a theoretical point of view, variations in the radiosensitivity of different elements in the normal skin should be borne in mind. Thus, Borak,[4] for instance, stated that the lethal dose is 1,200 r for the sebaceous and 2,500 r for the sudoriferous glands, while it is 2,000 r for the epidermis itself.

Development of metastatic lesions in the integument is usually indicative of rapid progression and early fatal termination. But, according to the literature, there are also exceptions to this rule,[7,8,20,24,28,37] although cases with "cancer en cuirasse" usually terminate fatally. Any treatment is palliative, and radiation therapy may be the method of choice.[24]

In the cases presented in this paper it was not known, with certainty, how extensively the cancer was disseminated. On the other hand, there was evidence that the cancer, at least in some instances, reacted favorably to local irradiation. However, the peculiar mode of growth caused dissemination outside the irradiated fields.

The following conclusion may be drawn: In skin carcinomas with sebaceous and/or sudoriferous structures, having an epidermal general architecture and mode of growth, and not too advanced, the results obtained with radiation treatment are about the same as those in ordinary skin carcinomas, provided that all the radiation factors are in correct relation to each other.

When treating these forms of skin carcinoma (correct microscopic diagnosis), the following possibilities are perhaps to be encountered:

(A) *Dermal Gland Carcinomas with Epidermal Properties in Their Histopathologic Make-up.*

(1) The primary cancer has been treated surgically, but no tumor remnants are to be found clinically (and microscopic examination shows the extirpation to have been adequate), and there is no evident dissemination. Treatment: checkup examination at rather short intervals.

(2) The primary cancer has been treated surgically, but tumor remnants are clinically suspected (or microscopic examination proves that the excision has not been adequate). Treatment: either a wide excision, or radium or roentgen irradiation as in the ordinary cutaneous carcinomas.

(3) The primary cancer was not treated earlier. Treatment: radium or roentgen irradiation as in paragraph (2).

(4) Metastases both in treated and in untreated cases. Treatment: regional lymph nodes are to be treated according to the general principles with irradiation and, possibly, "dissection en bloc."

(5) Recurrences. Treatment: (a) if irradiation has already been employed, the only possibility may be a wide excision; (b) if the primary treatment has been surgical, irradiation can be used as mentioned above.

(B) *Dermal Gland Carcinomas with "Mammary Gland Cancer"-like Appearance and Mode of Dissemination.*

If the cases are of the type described in the present paper, any treatment is palliative. From a theoretical point of view, hormone treatment may be tried.

SUMMARY

The therapy of dermal gland carcinomas as well as the effectiveness of surgical and radiation treatment of thirty-three of the author's cases are reported.

The present material contained two different types of dermal gland carcinomas: (1) carcinomas in which the microscopic architecture and mode of growth, as well as the general course of the disease, resembled that of actual epidermal cancer. This type was the most common one; (2) carcinomas in which the corresponding properties resembled those sometimes seen in cancer of the mammary (*i.e.*, modified apocrine sweat) glands.

It appeared that practically all tumors treated surgically recurred and/or metastasized.

On the contrary, carcinomas of the first type were cured if treated with irradiation, taking into account the general principles of irradiation technique.

Carcinomas with properties similar to those in mammary gland cancer were not cured.

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REGIONAL INTRA-ARTERIAL NITROGEN MUSTARD AS AN ADJUNCT TO RADIATION THERAPY*†

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THE intravenous administration of methyl-*bis* (β chloroethyl)-amine hydrochloride[7] and oral administration of triethylene melamine[8] have proved of value in the treatment of certain lymphomas but have had little effect on other cancers. Each agent, when given intravenously and intravenously and orally respectively, act in a fashion similar to total body irradiation. Therefore, it was logical to assume that if HN2 could be used regionally but more intensively, it might be possible to produce an effect similar to that of local irradiation and hence to influence other types of cancer. This hypothesis was tested by administering HN2 by close intra-arterial injection into cancer tissue, and positive results were obtained.[10] This paper does not represent purely the author's own work but will summarize certain results obtained and reported or to be reported by workers in our laboratories.

The presentation will describe (1) the method of administering therapy, (2) the objective measurable radiomimetic changes which indicate that the method is effective and (3) the evidence that fractionated intra-arterial HN2 therapy can be combined with roentgen therapy.

METHOD OF THERAPY

The methods used for intra-arterial injections have been of three types: (1) direct arterial puncture, (2) periodic arterial catheterization,[4] and (3) arterial cannulization.[10]

Our animal experiments[10] had demonstrated that the single intra-arterial injection of a sufficiently large dose of HN2 produced destruction of much of the normal tissue within the region supplied by the injected artery. On the analogy that a single sufficiently large dose of roentgen radiation produces unselective total tissue destruction while a smaller dose shows a selective tissue effect which can be made even more so by fractionation, our clinical studies have utilized the principle of multiple small injections given over a long period of time, this in contrast to the use of a single or a few large doses given over a short period of time. The latter method is an effective one for the treatment of tumors.[5]

Our clinical studies have employed only the cannulization method. With this technique, a polyethylene cannula is inserted into the artery into which injections are to be made and is kept in place for periods ranging from one to fourteen weeks. The method of insertion is the same as that described previously,[10] being patterned after that devised by Donovan[6] for the intra-arterial administration of heparin. The polyethylene tube is inserted through a proxi-

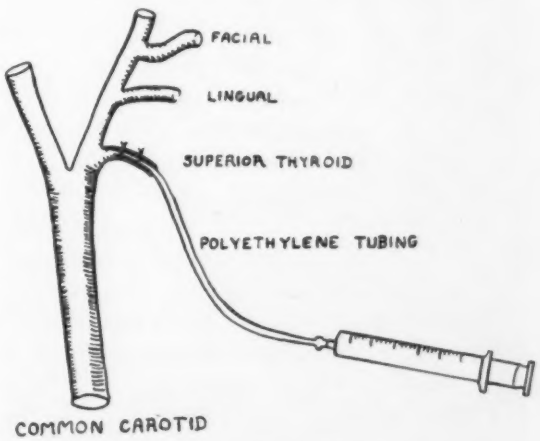

FIG. 1. Diagram of a method for cannulization of the external carotid artery.

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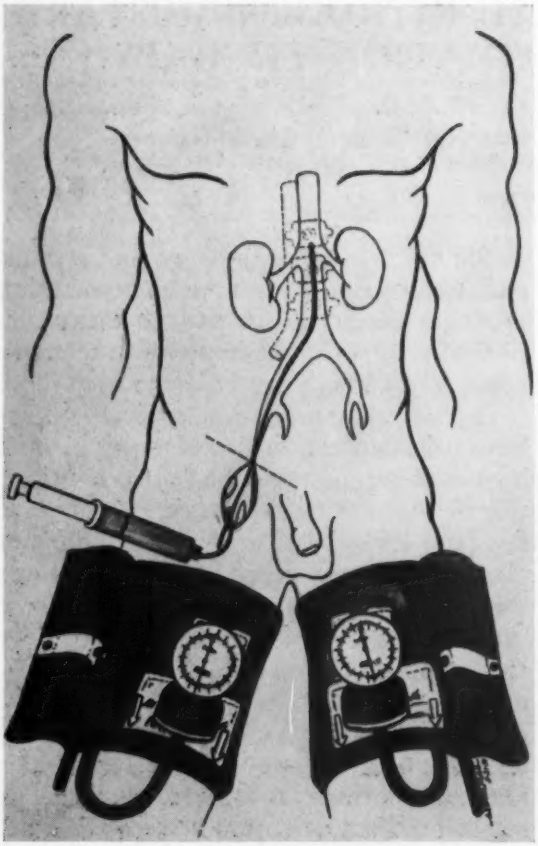

FIG. 2. Diagram of a method for cannulization of the aorta. Note blood pressure cuffs used as tourniquets at time of injection.

mal arterial branch, guided directly into the artery selected for injection, and secured by silk ligatures placed around the arterial branch over the tubing (Fig. 1). A suitable stopcock is placed on the end of the tubing and injections given through it at the desired intervals. No anticoagulant therapy has been used in our studies.

The method of cannulization employed in the treatment of pelvic tumors is slightly different[1] (Fig. 2). The cannula, inserted through a branch of the profunda femoral artery, is advanced in a retrograde fashion until it lies within the abdominal aorta at the desired height and is secured in the usual fashion. However, just preceding each injection, blood pressure cuffs are placed about both upper thighs and inflated to a pressure above the known systolic while the drug is being injected. The initially treated capillary bed is thus limited to the tissues of the pelvis, lower abdomen, and upper thighs.

Arteriograms have not been very successful in demonstrating the arterial tree into which the injections are given due primarily to the small size polyethylene tubing used.* Use of large size tubing is thought to be hazardous because of the prolonged periods during which the tube remains in place. However, the localization of the tip of the tubing can be determined

FIG. 3. First perceptible changes in mucous membrane of the rectum of the dog following the intra-aortic injection of HN_2.

by roentgenograms taken while the tubing is filled with diodrast or thorotrast. With this knowledge as to the location of the tip of the tubing, the arterial tree into which the injection is given can be satisfactorily described from a knowledge of the anatomy of the vessels.

In determining dosage schedules for HN_2 or any other drug which is to be injected intra-arterially, two more factors must be considered: (1) the sensitivity of the regional tissues, and (2) the systemic toxicity

* (.068×.042)—aeroflex. Anchor Plastics, New York, New York.

of the drug. In each instance in which a new region is to be treated or a new drug evaluated, preliminary animal experiments are advisable prior to clinical trials. This was demonstrated in the study of the effect of the intra-arterial administration of HN_2 on the pelvic structures.[1] It was found that the rectal mucosa of the dog is the local tissue most sensitive to the action of HN_2 and that characteristic microscopic changes in this epithelial tissue follow its administration (Fig. 3 and 4). Also, in rats, the

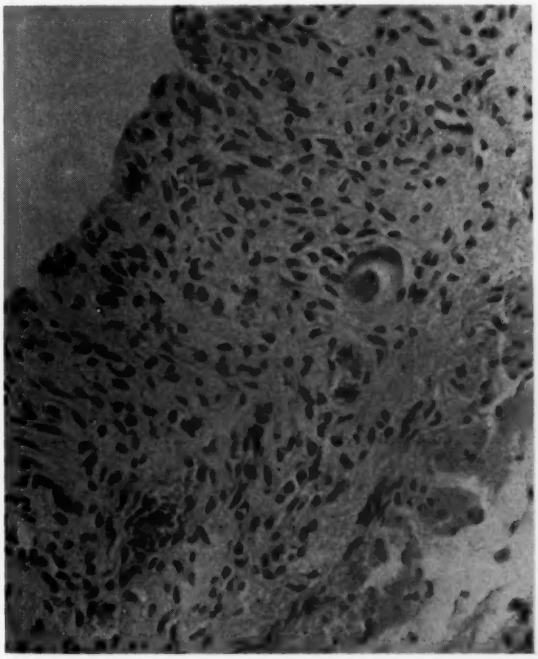

Fig. 4. Complete disappearance of glands of the rectum following a heavy course of intra-arterial HN_2 therapy.

dose of HN_2 which is lethal within a five day period to 50 per cent of the rats injected varies with the level of the aorta into which the injections are made, the point of greatest sensitivity lying within the colon, adrenals, gonads, and/or kidneys[3] (Table 1). For this reason, caution has been exercised in the therapy of intra-abdominal tissues.

Systemic toxicity to the HN_2 is measured primarily by the effect of the drug on the hematopoietic system, although electrolyte balance and immunological response may also be significantly altered.[2] Actually, the effect of HN_2 on the hematological picture is used at present to determine the time at which a given course of therapy must be terminated. In general, HN_2 injections are continued until the bone marrow shows: (1) a decrease in gen-

Table I

TOXICITY STUDIES ON THE EFFECTS OF THE INJECTION OF THE INTRAVENOUS LD_{50} DOSE OF HN2 INTO DIFFERENT POINTS OF THE AORTA OF THE RAT

	Per Cent Surviving on Fifth Day
Injected into aorta above level of adrenal artery	56
Injected into aorta below level of adrenal artery	73

(Mesenteric vessels occluded at time of injection.)

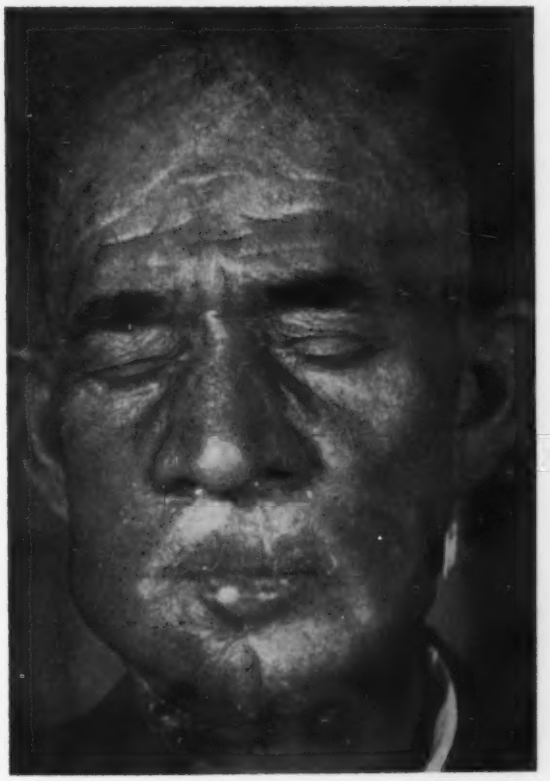

Fig. 5. Effect of a course of intra-arterial HN_2 therapy on the scalp and beard. Note loss of hair. The patient had not shaved for three weeks.

FIG. 6. Loss of hair following a course of intra-arterial HN_2 therapy. Note that epilation is limited to the occipital area, the temporal artery having been occluded during period of injection.

eral cellularity to 25 to 50 per cent of the original level, and (2) a differential count which shows a high percentage of mature forms and a low percentage of young cells.

The actual dosage schedules used are similar to those previously described;[1,10] namely, for pelvic cases, 2 milligrams of HN_2 every eight hours, and for faciomaxillary and intracranial cases 1 to 1.5 milligrams every eight hours. Total dosage varies widely.

OBJECTIVE THERAPEUTIC RADIOMIMETIC EFFECTS

The most dramatic radiation-like effect is the localized loss of hair which has been noted in scalp, beard (Fig. 5), and pubic areas.[10] This epilation usually occurred within two to three weeks of the beginning of a course of therapy but was not seen in cases in which the dosage schedules had been such as to produce little evidence of an intense local reaction. The extent of the area of epilation is limited to the field of distribution of the injected artery or arteries (Fig. 6), although at the edges the degree of epilation tends to fade out gradually rather than sharply. This is especially true at a midline boundary. The epilation can be prevented entirely by occlusion of the nutrient artery for the period covering the actual injection at a site between that of injection and that of the capillary bed.

As in irradiation, a local erythema occurs in seven to ten days if the treated region is of sufficiently small volume and the treatment of sufficient intensity. An erythema of the entire lower abdomen and thighs has never been seen following injection into the aorta. The most clearly defined example of the localized erythema occurs following injections into the internal carotid artery, where the skin erythema is limited to the area supplied by the ophthalmic branch of the artery (Fig. 7). The accurate limitation of the erythema was also illustrated in a

FIG. 7. Erythema of forehead following a course of HN_2 therapy given into the internal carotid artery. Note limitation of erythema to field supplied by the terminal branches of the opthalmic artery.

case of an intracranial tumor patient who had had a previous subtemporal decompression and whose dura in this area lay immediately beneath the scalp. In this patient, the loss of hair and erythema was limited to the area overlying the cranial defect and to the scalp areas supplied by the opthalmic artery (Fig. 8).

The effects of HN_2 on bone marrow are quite similar to those of irradiation. The localized effect of HN_2 on bone marrow was demonstrated by comparing samples obtained simultaneously from the pelvic marrow and the sternal marrow in patients who had received intra-aortic injections for the treatment of pelvic cancer[2] (Fig. 9 and 10). In all instances in which the arterial blood supply was intact, the marrow samples obtained from the iliac crest were significantly depressed as compared to the corresponding sternal marrow samples.

Fig. 8. Erythema and epilation of portion of scalp overlying subtemporal decompression following a course of HN_2 therapy given into the internal carotid artery.

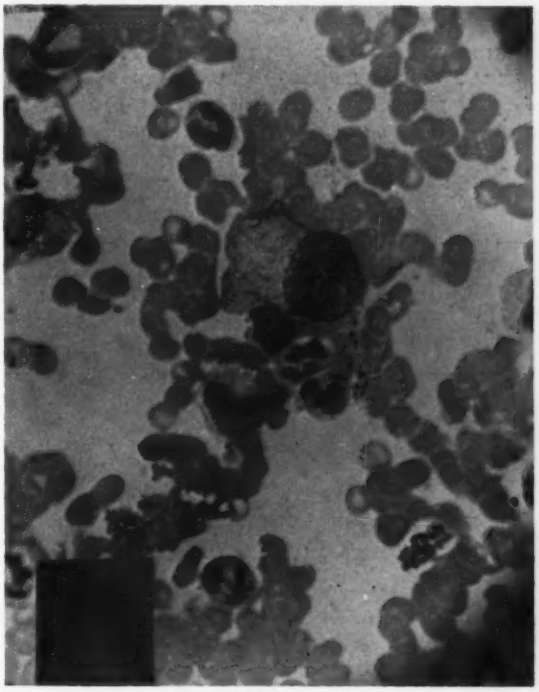

Fig. 9. Sternal bone marrow of patient receiving intra-arterial HN_2 therapy for cancer of cervix.

Quantitative estimation of the relative degree of iliac marrow depression is difficult if not impossible.

The effects on the cancer are also radiomimetic. This has been true of both epidermoid carcinomas[10] (Fig. 11, 12, 13, and 14) and adenocarcinomas[1] (Fig. 15, 16, 17, and 18). In general, the histopathological changes following intra-arterial HN_2 therapy are similar to those following local irradiation, and, with the dosages used, are best described as an accelerated radiation reaction. The microscopic changes are maximal in twelve to twenty days. The degree of the change cannot be predicted at present but some change is always present unless either the biopsy specimen has been obtained from the borders of the injected arterial tree or the injected arterial tree has been occluded at a point between injection site and the tumor.

There are differences in action between HN_2 and irradiation. For example, malignant tumors which are ordinarily considered as not sensitive to roentgen therapy will respond to HN_2. This has been true in

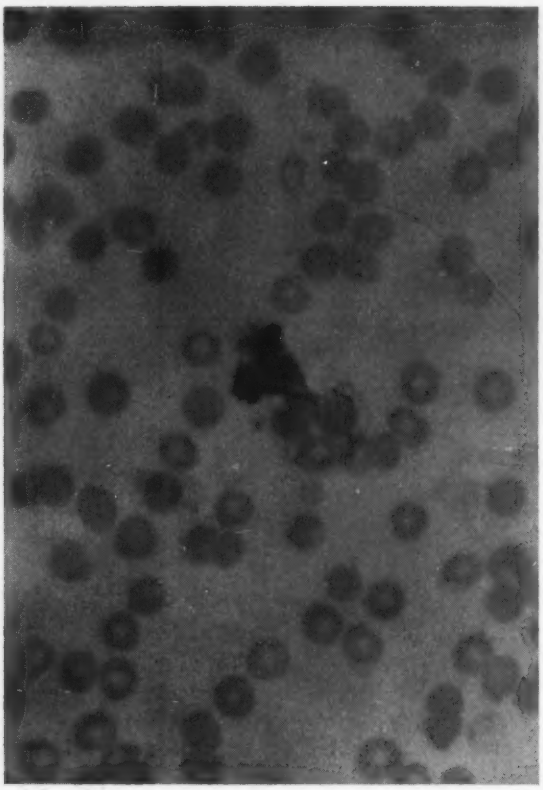

Fig. 10. Pelvic bone marrow of patient receiving intra-arterial HN2 therapy for cancer of cervix. Marrow obtained on same day as that shown in Figure 9.

the case of adenocarcinoma of the rectum,[1] soft tissue sarcoma,[10] and epidermoid cancer[10] which was recurrent within the field of previous irradiation. (It is this dissimilarity which most strongly supports the possibility that the use of intra-arterial HN2 plus roentgen therapy may be a method for improving the end results obtained by irradiation alone in the treatment of certain cancers.)

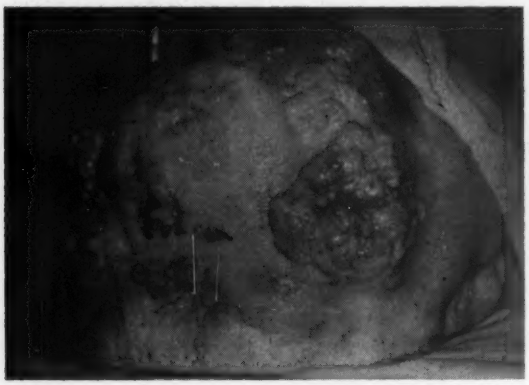

Fig. 11. Epidermoid carcinoma of buttocks, before treatment.

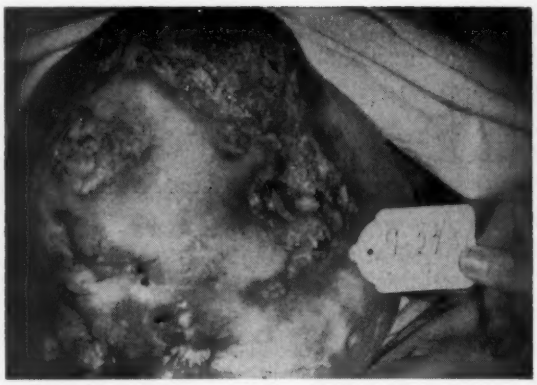

Fig. 12. Epidermoid carcinoma of buttocks following intra-arterial HN2 therapy. Note decreased nodularity and the increased intensity of effect in areas at greatest distance from the midline.

The changes in the gross appearance of the HN2 treated cancers are similar to

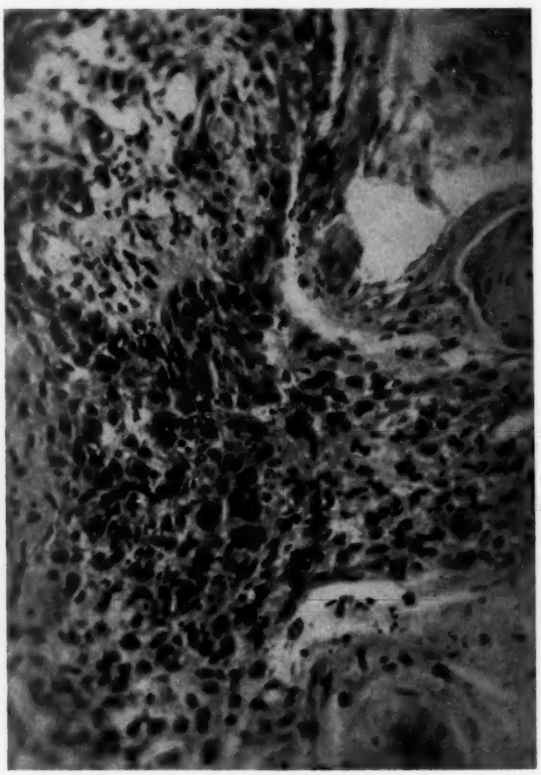

Fig. 13. Pretreatment biopsy, squamous carcinoma metastatic to mandible.

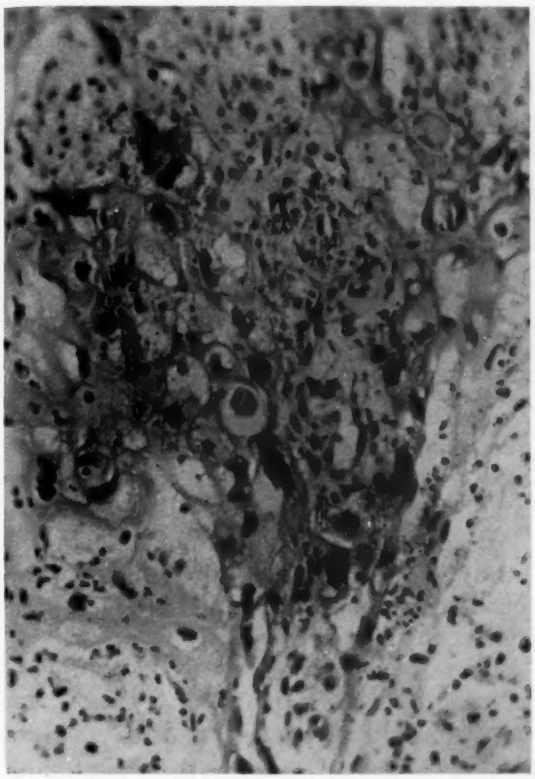

Fig. 14. Squamous carcinoma of mandible (same as Fig. 13) following intra-arterial HN_2 therapy.

those seen following a favorable response to roentgen therapy. Surface lesions become less nodular, and develop a clean granular base. Discharge increases initially and then becomes less. Small deep masses decrease in size and disappear. Large deep masses decrease somewhat, become softer, and often ulcerate and discharge copiously.

Fig. 15. Carcinoma of sigmoid; pretreatment photograph. Dark line outlines the abdominal mass.

Fig. 16. Carcinoma of sigmoid (same as Fig. 15) following intra-arterial HN_2 therapy. Note decrease in size of abdominal mass. Patient also received aureomycin.

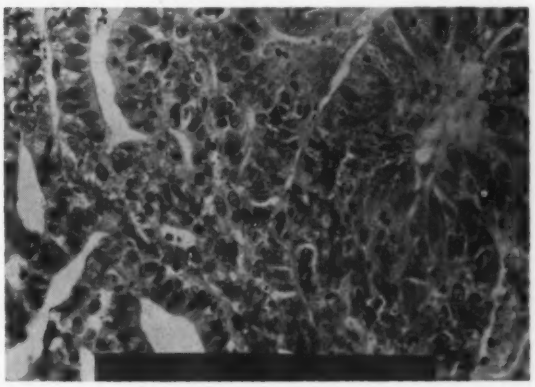

Fig. 17. Adenocarcinoma of rectum; pretreatment biopsy.

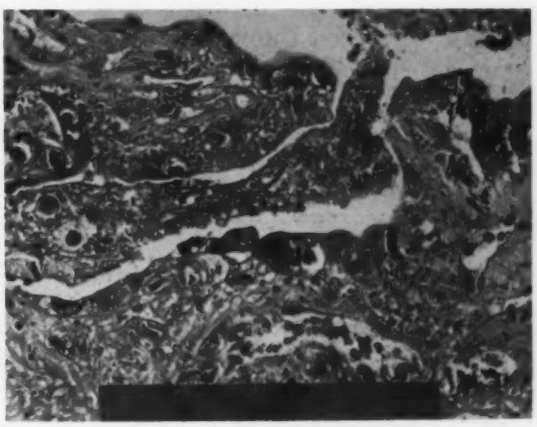

Fig. 18. Adenocarcinoma of rectum (same as Fig. 17) following intra-arterial HN_2 therapy.

TABLE II

PATIENTS RECEIVING INTRA-ARTERIAL HN2 AND ROENTGEN THERAPY CLASSIFIED ACCORDING TO REGION RECEIVING THERAPY

Pelvic	18
Faciomaxillary	7
Lower extremity	2
Intracranial	3
TOTAL	30

These radiomimetic changes which occur during and after therapy are objective criteria of the effect of therapy and as such are easier to evaluate than the subjective ones. It is for this reason that relief of local pain, which has been a prominent effect following intra-arterial HN_2 therapy in almost all cases in which pain was present, has not been stressed in this presentation, nor included as a radiomimetic effect.

COMBINED REGIONAL USE OF HN2 AND RADIATION THERAPY

As there was no cancer available in a sufficiently large experimental animal, it was necessary to proceed with cancer patients. For this reason the studies were limited almost entirely to advanced cancer patients and were conducted rather slowly and cautiously. Karnofsky and associates[9] had shown that the effects of total body irradiation and total body HN_2 therapy were additive in small animals but that a larger dosage was tolerated if the HN_2 therapy preceded the irradiation. For this reason, whenever possible, this sequence was used but often other clinical factors made this impossible.

TABLE III

PATIENTS RECEIVING INTRA-ARTERIAL HN2 AND ROENTGEN THERAPY CLASSIFIED ACCORDING TO THE TIME INTERVAL BETWEEN BOTH MODES OF THERAPY

	Cases
Group I: HN_2 therapy preceding irradiation	
(a) by an interval greater than one month	2
(b) by an interval less than one month...	5
Group II: Irradiation preceding HN_2 therapy	
(a) by an interval greater than one month	21
(b) by an interval less than one month...	2
TOTAL	30

TABLE IV

	Cases	Effective in
Group I (a)		
Pelvic	1	1
Epidermoid carcinoma of buttocks*		
Faciomaxillary	1	1
Recurrent carcinoma of lip*		
TOTAL	2	2

* Course of irradiation incomplete.

A total of 30 cases is included in this study, representing the patients upon whom observations were completed at the time the report was prepared.

The cases are summarized according to anatomical region treated in Table II, and according to interval between HN_2 and roentgen therapy in Table III.

The results of therapy are summarized by groups in Tables IV, V, VI, and VII. No attempt has been made to quantitate degree of effectiveness which is defined as evidence of effect on the tumor as measured by any one of the objective criteria previously described.

These cases, all of which have been or will be reported in greater detail elsewhere, were analyzed at this time to determine

TABLE V

	Cases	Effective in
Group I (b)		
Pelvic		
Epidermoid carcinoma of cervix*	3	3
Faciomaxillary		
Squamous carcinoma of tongue..	1	1
Intracranial		
Squamous carcinoma metastatic to brain	1	1
TOTAL	5	5

* Skin reactions to irradiation appeared more intense than expected.

(1) if previously irradiated cancer would still respond to intra-arterially administered HN_2; (2) if cancer previously treated by intra-arterially administered HN_2 could be given a subsequent full course of irradiation without ill effect. No attempt is made to determine at this time whether previously administered intra-arterial HN_2 improves the effectiveness of a subsequent course of therapeutic irradiation.

The results, as indicated in Tables III and IV, demonstrate that a previous course

TABLE VI

	Cases	Effective in
Group II (a)		
Pelvic		
Osteogenic sarcoma	1	1
Epidermoid carcinoma of cervix	8	7
Epidermoid carcinoma of vagina	1	0
Adenocarcinoma of cervix	1	1
Adenocarcinoma of rectum	2	2
Adenocarcinoma of prostate	1	1
Faciomaxillary		
Adenocarcinoma of salivary gland	1	1
Epidermoid carcinoma of tongue	2	2
Epidermoid carcinoma of antrum	1	1
Intracranial		
Primary brain tumor	2	2
Extremity		
Fibrosarcoma	1	1
TOTAL	21	19

of therapeutic irradiation does not block the effectiveness of intra-arterially administered HN_2. It is our impression that it also does not increase the sensitivity of surrounding normal regional tissues to HN_2, but that the response of these previously irradiated tumors was not as good as that noted in similar previously untreated cancers.

As indicated in Tables III and IV a small number of cases have been followed after the reverse form of therapy. As it has been demonstrated that HN_2 followed by total body roentgen therapy is preferable to the reverse order of therapy,[9] combined treatment as given to Group I patients would be preferable. However, because of the similarity of action between HN_2 and irradiation, caution was in order as irreparable tissue necrosis might occur if the effects on tissue were additive. The observations on patients in Group I indicate that the immediate skin reactions to the full course of roentgen therapy may have been more intense in patients in Group I(b) but no other ill effects were noted. The 3 cases of cervical cancer in Group I(b) have now been followed five, six, and seven months respectively and no late sequelae have been noted. Hence, this method of therapy can be stated to be sufficiently free of sequelae to permit its subsequent use in a larger series of advanced cancer patients and such use may be advantageous.

TABLE VII

	Cases	Effective in
Group II (b)		
Faciomaxillary		
Squamous carcinoma of lip	1	1
Pelvic		
Epidermoid carcinoma of cervix	1	0
TOTAL	2	1

The radiation therapy utilized in the pelvic cancer cases is given in Table VIII in terms of the tumor dose. These represent a standard course of therapy as given in our clinic.

While the methods described for intra-arterial therapy are still in use, modifications are being tested in order to keep to an absolute minimum complications and

TABLE VIII

RADIATION THERAPY RECEIVED BY THE CERVICAL CANCER PATIENTS IN GROUP I (B)

	Tumor Dose	
	Roentgen rays	Radium
Case I	3,600 r	2,500 r_γ
Case II	3,700 r	4,900 r_γ
Case III	3,000 r	None

The radiation therapy was administered by Dr. Keene Wallace. The uterine cervix cancers were treated by Dr. J. K. Cromer.

surgical expense. In a few instances,[11] clinically significant arterial thrombosis has occurred, and in 1 instance an embolus was produced. Also, significant degrees of infection have been seen but these are minimal since adequate concomitant antibiotic therapy has been employed.

SUMMARY

1. A method for intra-arterial cancer chemotherapy is described.

2. The radiomimetic effects of intra-arterial nitrogen mustard therapy are described.

3. Evidence is presented which indicates that a previous course of therapeutic irradiation does not prevent a response to subsequent intra-arterial HN_2 therapy; also, that a full course of intra-arterial HN_2 therapy can be combined with a standard course of radiation therapy without immediate evidence of overdosage to local tissues.

1339 H St., N.W.
Washington 5, D. C.

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Vol. 70, No. 6

THE EFFECT OF ACTH AND CORTISONE ON THE ERYTHEMA REACTION TO LOW KILOVOLTAGE RADIATION*

By PABLO L. MORALES, M.D.
NEW YORK, NEW YORK

THE reaction of skin to tuberculin and beta hemolytic streptococcus vaccine in humans has been shown to be diminished by the administration of ACTH or cortisone.[1] In view of the possibility of altering the skin reaction to roentgen radiation by the use of these hormones and the fact that this hormone therapy is in frequent use today in patients who might also require radiation therapy, it seemed desirable to determine if the skin reaction to roentgen irradiation was altered in patients under cortisone or ACTH therapy.

PROCEDURE

In a group of 12 clinic patients given 300 r, in air, to a 3 cm. circular field at the volar aspect of the forearm, an erythema appeared in 9 of the subjects in five days. The following factors were used: 120 kv., 5 ma., no filtration, target skin distance, 20.4 cm., and half-value layer 0.8 mm. Al.

A group of 12 hyperadrenalized patients receiving a maintenance dose of ACTH or cortisone for rheumatoid arthritis were given doses of 350 r in air, 300 r in air, and 200 r in air to the volar aspect of the forearm. As controls, similar doses were given to a group of 7 patients who were not on hormone therapy. The same factors as detailed above were used. Daily observations were made on all subjects.

In order to make the observations as objective as possible members of the staff not acquainted with the fields of treatment were asked to locate the presence of an erythema, since there is a tendency to falsely interpret the presence of erythema reactions when one knows the exact location where they are expected. A different observer viewed the cases each day.

RESULTS

Table 1 indicates the day of onset of the erythema reaction following the roentgen irradiation on both the treated and control groups.

TABLE I

Number of Cases	Appearance of Erythema Days after Irradiation							No Reaction
	1	2	3	4	5	6	7	
Group receiving 350 r								
On drug—14	6	4	2	2				
Controls— 9	5	2	1	1				
Group receiving 300 r								
On drug—12	2	3	3	1				3
Controls— 7	3	1	1	1				1
Group receiving 200 r								
On drug—12	0	1	5	2				4
Controls— 7	2	1	0	2				2

In the group receiving 350 r, 2 patients were irradiated on two occasions, once at the beginning of the ACTH therapy and the other after the patient had been on ACTH therapy for several days. All the other patients were treated on only one occasion.

Table 1 shows that there is no significant difference in either group. The intensity of the reaction also was found to be an individual variation rather than a difference between the two groups. All cases in both groups receiving 350 r, measured in air, developed an erythema.

SUMMARY AND CONCLUSION

The skin reaction to 200 r, 300 r, and 350 r of roentgen radiation (half-value layer 0.8 mm. Al), as measured by the onset of an erythema, was compared in a group of patients receiving ACTH or cortisone therapy with a control group. No difference in time of onset or intensity of the reaction was observed.

* From the Department of Radiology, the Presbyterian Hospital, New York, New York.

I wish to express my deep appreciation to Dr. Edith H. Quimby and Dr. Morton M. Kligerman from the Departments of Radiological Research and Radiology of the College of Physicians and Surgeons and The Presbyterian Hospital for their advice and guidance in the preparation of this manuscript.

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Vol. 70, No. 6

THE AMERICAN JOURNAL OF ROENTGENOLOGY, RADIUM THERAPY AND NUCLEAR MEDICINE

Editor: Lawrence Reynolds, M.D. *Assistant Editor:* Ruth Bigelow, B.S.

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Fifty-fifth Annual Meeting: Shoreham Hotel, Washington, D. C., September 21–24, 1954.

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Thirty-sixth Annual Meeting: The Homestead, Hot Springs, Virginia, March 14, 15 and 16, 1954.

EDITORIAL

THE FIFTY-FOURTH ANNUAL MEETING OF THE AMERICAN ROENTGEN RAY SOCIETY

THE Fifty-fourth Annual Meeting of the American Roentgen Ray Society, which was held at the Netherland Plaza, Cincinnati, Ohio, from September 29 to October 2, 1953, was a most pleasant and profitable one from beginning to end. The program which had been arranged by President-elect Weber and his committee proved to be most interesting and instructive. The Scientific Session was opened on Tuesday morning by the Call to Order by President Martin, and the Address of Welcome by Dr. Stanley E. Dorst, Dean of the University of Cincinnati College of Medicine was a splendid prologue to the Installation of President-elect Harry M. Weber. President Weber chose as the subject of his Inaugural Address "The Contribution of Roentgenologic Examination to the Diagnosis of Curable Cancer of the Alimentary Tract." No one is more capable of speaking on such an important subject than is Dr. Weber and certainly his address was an excellent tribute to the progress of radiology throughout these many years. It pointed not only to the advances that have been made in diagnostic roentgenology, particularly dealing with the alimentary tract, but to the future trends in roentgenologic examination that will further enhance the value of this type of examination. It is a most hopeful sign that Dr. Weber called attention to the diagnosis of curable cancer in the alimentary tract which is a far cry from the early days of roentgenology when about all that might be done was to arrive at a diagnosis with very little hope of cure in the vast majority of cases. This address itself is one of the signposts in the advancement of roentgenology.

Dr. Weber's inaugural address was followed by stimulating discussions dealing with the various phases of roentgenological subjects participated in by leaders in the medical world throughout this country and from abroad.

Many of the recent advances in angiocardiographic studies were reported by various essayists, and one of the highlights of the meeting was a symposium on Mitral Stenosis which included a discussion of Anatomic and Pathologic Considerations, Clinical Aspects and Physiologic Changes, Operating Technique and Observations Made During Operation, Roentgenologic Considerations and Summary of the discussions dealing with mitral stenosis. This was a comprehensive and excellent presentation of a timely subject in which roentgenologists must interest themselves because of the great advancements in the surgical technique of dealing with such a protean disease.

The program was a fairly evenly balanced one dealing not only with the diagnostic aspects of radiology but the therapeutic aspects as well. Another symposium given at the meeting was on Radiation Protection in which attention was called to the Effects of Chronic and Acute Exposure, Reversible and Irreversible Biological Effects of Radiation and the Treatment of Radiation Injuries. Other papers in the symposium dealt with the Instruments Used for Measuring Exposure to Personnel, namely, ionization chambers, Geiger counters, film badges: their characteristics, limitations and probable errors. Another took up the Problems of Exposure to Radiation in Diagnostic Radiology, a subject that is too often neglected not only by the

radiologists themselves but by the personnel in the department, particularly in these latter days with the modern types of angiographic studies of various kinds that are being carried out in the radiological departments with too infrequent consideration of the exposure hazards entailed in such procedures. Other papers in the symposium dealt with Problems of Exposure to Radiation in Therapeutic Radiology, and Health Problems in a Radioisotope Laboratory. These papers are of vital importance to the radiologist as well as to those who work strictly in the radioisotope laboratories. Radioisotopes, by the way, may prove to be one of the most hazardous of the group of radiation sources because of the careless manner in which they are too frequently handled.

Another group of papers of extreme interest was one dealing with the small intestine, especially the Roentgen Studies of the Effects of Emotional Disturbances on the Small Intestine and Roentgen Studies of the Small Intestine in Sprue, in which the differential diagnosis between sprue and other disorders of the small intestine were discussed, and a third paper on Amyloidosis of the Small Intestine. The whole group of papers dealing with the small intestine provoked a great amount of interest; indeed all the papers given at the Society's meeting, which it is not possible to mention here, were of manifest importance to all those having to do with radiological problems in both their diagnostic and therapeutic aspects.

The Caldwell Lecture was given on Tuesday evening by Dr. Paul C. Hodges, Professor and Head of the Department of Radiology, University of Chicago, Chicago, Illinois. He chose as his subject "Normal Bone, Diseased Bone, Dead Bone." Dr. Hodges' pre-eminence in the knowledge of the subject which he discussed was assurance that the lecture would be both interesting and instructive and such it proved to be.

The Instruction Courses which have for some time been of importance to the annual meetings were given this year under the Directorship of Dr. B. R. Kirklin, and the various courses offered attracted a large group of interested individuals. The Scientific Exhibit was a comprehensive one and was most attractively arranged. The time allowed for viewing the Scientific and Commercial Exhibits made it possible for members of the Society and their guests to study both exhibits and it is anticipated that at the forthcoming meetings of the Society this allotted period will be adhered to.

The Commercial Exhibits at this year's meeting were of an exceptional quality and character and attracted the attention of all those present at the meetings. Elsewhere in this issue will be found a comprehensive discussion of the Scientific Exhibits and a list of the Commercial Exhibitors.

While the scientific part of the meeting occupied the most part of each day, no meeting would be complete without its social aspects, and to the Committee on Local Arrangements under the able chairmanship of Dr. Harold G. Reineke the Society is indebted for the meticulous details of the social programs which they arranged. On Monday preceding the beginning of the meeting the Annual Golf Tournament was held at the Kenwood Country Club. Competition was for the Willis F. Manges Trophy and for the Exhibitors' Trophy. The tournament was followed by the Annual Golf Dinner at the Club. As usual, on Thursday evening the Annual Banquet, preceded by cocktails, took place in the beautiful Pavillon Caprice. On this occasion Dr. Weber made the presentation of awards to the exhibitors whose scientific exhibits had been chosen as the most outstanding. The banquet was followed by most enjoyable entertainment and dancing. An enjoyable program of dinners, luncheons and trips had been arranged for the visiting ladies by the local committee under the chairmanship of Mrs. Harold G. Reineke.

To the Cincinnati Convention Bureau and its manager Mr. J. S. Turner the Society expresses its thanks and appreciа-

tion for the very efficient manner in which the registration was carried out. For the management and the staff of the Netherland Plaza the Society has nothing but its gratitude and thanks for the splendid manner in which they carried out every detail of the arrangements that were made both by the Local Committee and the Society.

If one may judge by comments which were heard, it was the consensus of those attending the meeting that it was an excellent one in all respects and one of which the Society might well be proud.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. Barton R. Young, Germantown Hospital, Philadelphia 44, Pa. Annual meeting: Shoreham Hotel, Washington, D.C., Sept. 21–24, 1954.

American Radium Society
Secretary, Dr. R. E. Fricke, Mayo Clinic, Rochester, Minn. Annual meeting: The Homestead, Hot Springs, Virginia, March 14–16, 1954.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 713 E. Genesee St., Syracuse 2, N. Y. Annual meeting: Palmer House, Chicago, Ill. Dec. 13–18, 1953.

American College of Radiology
Executive Secretary, William C. Stronach, 20 N. Wacker Drive, Chicago 6, Illinois.

Section on Radiology, American Medical Association
Secretary, Dr. T. Leucutia, Harper Hospital, Detroit 1, Mich. Annual meeting: 1954, to be announced.

Fifth Inter-American Congress of Radiology
General Secretary, Dr. Eugene P. Pendergrass, 3400 Spruce St., Philadelphia 4, Pa. Meets at Shoreham Hotel, Washington, D. C., April 24–30, 1955.

Alabama Radiological Society
Secretary, Dr. J. A. Meadows, Jr., Medical Arts Bldg., Birmingham 5, Ala. Meets time and place Alabama State Medical Association.

Arizona Radiological Society
Secretary, Dr. R. Lee Foster, 507 Professional Bldg., Phoenix, Ariz. Two regular meetings a year. The annual meeting at time and place of State Medical Association and interim meeting six months later.

Arkansas Radiological Society
Secretary, Dr. Fred Hames, 511 National Bldg., Pine Bluff, Ark. Meets every three months and also at time and place of State Medical Association.

Atlanta Radiological Society
Secretary, Dr. Albert A. Rayle, Jr., 478 Peachtree St., N.E., Atlanta, Ga. Meets monthly, except during three summer months, on second Friday evening.

Brooklyn Roentgen Ray Society
Secretary, Dr. J. J. Daversa, 345 75th St., Brooklyn, N. Y. Meets monthly fourth Tuesday, October through April.

Buffalo Radiological Society
Secretary, Dr. Mario C. Gian, 610 Niagara St., Buffalo, N. Y. Meets second Monday evening each month, October to May inclusive.

Central New York Roentgen Ray Society
Secretary, Dr. Dwight V. Needham, 608 E. Genesee St., Syracuse N. Y. Meets January, May, November.

Central Ohio Radiological Society
Secretary, Dr. F. A. Riebel, 15 West Goodale St., Columbus, Ohio. Meets at 6:30 P.M. on second Thursday of October, December, February, April, and June at Columbus Athletic Club, Columbus, Ohio.

Chicago Roentgen Society
Secretary, Dr. Elbert K. Lewis, 6337 S. Harvard Ave., Chicago, Ill. Meets second Thursday of each month, October to April inclusive at the University Club.

Cleveland Radiological Society
Secretary, Dr. Mortimer Lubert, 10515 Carnegie Ave., Cleveland 6, Ohio. Meetings at 6:45 P.M. on fourth Monday of each month from October to April.

Colorado Radiological Society
President, Dr. W. P. Stampfli, St. Luke's Hospital, Denver, Colo. Meets third Friday of each month at University of Colorado Medical Center or at Denver Athletic Club.

Connecticut Valley Radiologic Society
Secretary, Dr. E. W. Godfrey, 1676 Boulevard, West Hartford, Conn. Meets second Friday October and April.

Dallas-Fort Worth Roentgen Study Club
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meets in Dallas on odd months and in Fort Worth on even months, on third Monday, 7:30 P.M.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. E. F. Lang, Harper Hospital, Detroit, Mich. Meets monthly first Thursday, October to May, at Wayne County Medical Society Building.

East Bay Roentgen Society
Secretary, Dr. Dan Tucker, 434 30th St., Oakland 9, Calif. Meets first Thursday each month at Peralta Hospital, Oakland.

Florida Radiological Society
Secretary, Dr. H. G. Reaves, Medical Arts Bldg., Sarasota, Fla. Meets twice annually, in the spring with the annual State Society meeting, and in the fall.

Georgia Radiological Society
Secretary, Dr. Robert M. Tankesley, 218 Doctors Bldg., Atlanta, Ga. Meets in mid-winter and at annual meeting of Medical Association of Georgia in the spring.

Greater Miami Radiological Society
Secretary, Dr. E. H. Bryson, 273 Alhambra Circle, Coral Gables, Fla. Meets third Wednesday of each month at Veterans Administration Building.

Houston Radiological Society
Secretary, Dr. Harry Fishbein, 324 Medical Arts Bldg., Houston 2, Texas. Meets fourth Monday each month at Hermann Hospital.

Idaho State Radiological Society
Secretary, Dr. Alfred M. Stone, St. Lukes Hospital, Boise, Idaho. Meets annually at same time as Idaho State Medical Association.

Illinois Radiological Society
Secretary, Dr. Stephen L. Casper, 1101 Maine St., Quincy, Ill. Meets three times a year.

Indiana Roentgen Society
Secretary, Dr. William M. Loehr, 712 Hume-Mansur Bldg., Indianapolis 4. Meets second Sunday in May.

Iowa Radiological Society
Secretary, Dr. James T. McMillan, 1104 Bankers Trust Bldg., Des Moines, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society. The scientific section is held in the autumn.

Kansas Radiological Society
Secretary, Dr. Willis L. Beeler, M.D., 700 Kansas Ave., Topeka, Kansas. Meets in spring with State Medical Society, and in winter on call.

Kentucky Radiological Society
Secretary, Dr. E. L. Pirkey, Louisville General Hospital, Louisville 2, Ky. Meets monthly on second Friday at Seelbach Hotel, Louisville.

Kings County Radiological Society
Secretary, Dr. Solomon Maranov, 1450 51st St., Brooklyn 19, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:45 P.M.

Los Angeles Radiological Society
Secretary, Dr. George Jacobson, 1200 N. State St., Los Angeles 33, Calif. Meets second Wednesday each month at Los Angeles County Medical Association Building, Los Angeles.

* Secretaries of societies are requested to send timely information promptly to the Editor.

MAINE RADIOLOGICAL SOCIETY
Secretary, Dr. Hugh Allan Smith, Eastern Maine General Hospital, Bangor, Maine. Meets in early spring, June and fall.

MARYLAND RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. H. Leonard Warres, 2337 Eutaw Place, Baltimore 17, Maryland.

MIAMI VALLEY RADIOLOGICAL SOCIETY
Secretary, Dr. G. A. Nicoll, 134 Apple St., Dayton, Ohio. Meets second Friday of fall and winter months.

MID-HUDSON RADIOLOGICAL SOCIETY
Secretary, Dr. J. W. Walton, Horton Memorial Hospital, Middletown, N. Y. Meets 8:30 P.M., fourth Tuesday each month, September to May.

MILWAUKEE ROENTGEN RAY SOCIETY
Secretary, Dr. T. J. Pfeffer, 839 N. Marshall St., Milwaukee 2, Wis. Meets monthly on second Monday at University Club.

MINNESOTA RADIOLOGICAL SOCIETY
Secretary, Dr. John R. Hodgson, Mayo Clinic, Rochester, Minn. Meets three times annually, once at time of State Med. Assn., and in spring and fall.

MISSISSIPPI RADIOLOGICAL SOCIETY
Secretary, Dr. John W. Evans, 117 N. President St., Jackson, Miss. Meets third Thursday of each month at the Rotisserie Restaurant at 6:30 P.M.

MONTANA RADIOLOGICAL SOCIETY
Secretary, Dr. Grant P. Raitt, Suite 413 Medical Arts Bldg., Billings, Montana. Will meet at least once a year.

NASSAU RADIOLOGICAL SOCIETY
Secretary, Dr. Frank Huber, Hempstead, N. Y. Meets second Tuesday of the month in February, April, June, October and December.

NEBRASKA RADIOLOGICAL SOCIETY
Secretary, Dr. J. F. Kelly, Jr., 816 Medical Arts Bldg., Omaha, Nebr. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. Stanley M. Wyman, Massachusetts General Hospital, Boston, Mass. Meets monthly on third Friday, Harvard Club.

NEW HAMPSHIRE ROENTGEN RAY SOCIETY
Secretary, Dr. A. C. Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. J. R. Freid, 1049 Park Ave., New York 28, N. Y. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

NORTH CAROLINA RADIOLOGICAL SOCIETY
Secretary, Dr. W. C. Sternbergh, Charlotte Memorial Hospital, Charlotte, N. C. Meets in May and October.

NORTH DAKOTA RADIOLOGICAL SOCIETY
Secretary, Dr. C. O. Heilman, 807 Broadway, Fargo. Meetings by announcement.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY
Secretary, Dr. D. H. Baxter, Albany Hospital, Albany, N. Y. Meets in Albany area on second Wednesdays of October, November, March and April.

NORTHERN CALIFORNIA RADIOLOGICAL SOCIETY
Secretary, Dr. H. B. Stewart, 2920 Capitol Ave., Sacramento, Calif. Meets at dinner last Monday of each month, September to June.

OHIO STATE RADIOLOGICAL SOCIETY
Secretary, Dr. M. M. Thompson, 316 Michigan St. Toledo, Ohio.

OKLAHOMA STATE RADIOLOGICAL SOCIETY
Secretary, Dr. John R. Danstrom, Medical Arts Bldg., Oklahoma City, Okla. Three regular meetings annually.

OREGON RADIOLOGICAL SOCIETY
Secretary, Dr. J. W. Loomis, 919 Taylor St. Bldg., Portland 5, Oregon. Meets monthly from October to June on the second Wednesday of each month at 8:00 P.M. at the University Club.

ORLEANS PARISH RADIOLOGICAL SOCIETY
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets first Tuesday of each month.

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY
Secretary, Dr. S. J. Hawley, 1320 Madison St., Seattle 4, Wash. Meets annually in May.

PACIFIC ROENTGEN SOCIETY
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

PENNSYLVANIA RADIOLOGICAL SOCIETY
Secretary, Dr. J. M. Converse 416 Pine St., Williamsport. Next annual meeting at Bedford Springs Hotel, Bedford, Penna., May 14 and 15, 1954.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. H. M. Stauffer, Temple University Hospital, Philadelphia 40, Pa. Meets first Thursday of each month, at 5 P.M., from October to May in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY
Secretary, Dr. Donald H. Rice, Western Pennsylvania Hospital, Pittsburgh 24, Pa. Meets 6:00 P.M. at Webster Hall Hotel on second Wednesday each month, October to May inclusive.

RADIOLOGICAL SECTION, BALTIMORE MEDICAL SOCIETY
Secretary, Dr. H. Leonard Warres, 2337 Eutaw Place, Baltimore 17, Md. Meets third Tuesday each month, September to May, inclusive.

RADIOLOGICAL SECTION, CONNECTICUT MEDICAL SOCIETY
Secretary, Dr. William A. Goodrich, 85 Jefferson St., Hartford 6, Conn. Meetings are held bi-monthly.

RADIOLOGICAL SECTION, MEDICAL SOCIETY OF THE DISTRICT OF COLUMBIA
Secretary, Dr. A. C. Wyman, 5445—28th St., N.W., Washington, D. C. Meets Medical Society Library, third Wednesday of January, March, May and October at 8:00 P.M.

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Secretary, Dr Roy G. Giles, Temple, Texas.

RADIOLOGICAL SOCIETY OF GREATER CINCINNATI
Secretary, Dr. Chapin Hawley, 927 Carew Tower, Cincinnati 2, Ohio. Meets monthly from September to June on first Monday of each month at 7:30 P.M. at the Cincinnati General Hospital.

RADIOLOGICAL SOCIETY OF HAWAII
Secretary, Dr. P. S. Arthur, Young Hotel Bldg., Honolulu 13, T. H. Meets third Friday of each month at a place designated by the Secretary.

RADIOLOGICAL SOCIETY OF KANSAS CITY
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

RADIOLOGICAL SOCIETY OF LOUISIANA
Secretary, Dr. J. T. Brierre, 700 Audubon Bldg., New Orleans. Meets annually during Louisiana State Medical Society Meeting.

RADIOLOGICAL SOCIETY OF NEW JERSEY
Secretary, Dr. Salomon Silvera, 921 Bergen Ave., Jersey City, N. J. Meets at Atlantic City at time of State Medical Society and in November in Newark, N. J.

RICHMOND COUNTY RADIOLOGICAL SOCIETY
Secretary, Dr. W. F. Hamilton, Jr., University Hospital, Augusta, Ga.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. A. Gordon Ide, 277 Alexander St., Rochester 7, N. Y. Meets at 8:15 P.M. on the last Monday of each month, September through May, at Strong Memorial Hospital.

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY
Secretary, Dr. John H. Freed, 4200 East Ninth St., Denver 7, Colo.

ST. LOUIS SOCIETY OF RADIOLOGISTS
Secretary, Dr. Francis O. Trotter, Jr., 634 N. Grand Blvd., St. Louis 3, Mo. Meets fourth Wednesday each month, except June, July, August and September.

San Antonio-Military Radiological Society
Secretary, Dr. Hugo F. Elmendorf, Jr., 730 Medical Arts Bldg., San Antonio 5, Texas. Meets Brook Army Medical Center Officers Mess first Monday of each month.

San Diego Radiological Society
Secretary, Dr. C. W. Bruner, 2456 Fourth Ave., San Diego 1, Calif. Meets first Wednesday of each month at the University Club.

San Francisco Radiological Society
Secretary, Dr. I. J. Miller, 2680 Ocean Avenue, San Francisco 27, Calif. Meets quarterly.

Section on Radiology. California Medical Association
Secretary, Dr. H. R. Morris, 1027 "D" St., San Bernardino, Calif.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. George E. Irwin, Jr., 703 N. East St., Bloomington, Ill.

Shreveport Radiological Club
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

South Bay Radiological Society
Secretary, Dr. W. H. Graham, 634 East Santa Clara St., San Jose 12, Calif. Meets second Wednesday each month.

South Carolina Radiological Society
Secretary, Dr. William A. Klauber, Self Memorial Hospital, Greenwood, S. C. One meeting with South Carolina Medical Association in May, others arranged by President.

Tennessee Radiological Society
Secretary, Dr. G. K. Henshall, 311 Medical Arts Bldg., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. R. P. O'Bannon, 650 Fifth Ave., Fort worth 4, Texas. Next meeting, Dallas, Texas, Jan. 29 and 30, 1954.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7:00 P.M. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets first and third Thursdays 4:00 to 5:00 P.M., September to May, Service Memorial Institute.

Utah State Radiological Society
Secretary, Dr. Angus K. Wilson, 343 S. Main St., Salt Lake City 1, Utah. Meets third Wednesday in September, November, January, March and May.

Virginia Radiological Society
Secretary, Dr. P. B. Parsons, Norfolk General Hospital, Norfolk, Va. Meets annually in October.

Washington State Radiological Society
Secretary, Dr. John N. Burkey, 555 Medical-Dental Bldg., Seattle 1, Wash. Meets fourth Monday of each month from September through May.

West Virginia Radiological Society
Secretary, Dr. W. Paul Elkin, 515 Medical Arts Bldg., Charleston, W. Va. Meets concurrently with annual meeting of West Virginia State Medical Society; other meetings arranged by program committee.

Westchester Radiological Society
Secretary, Dr. C. G. Huntington, 170 Maple Ave., White Plains, N. Y. Meets on third Tuesdays of January and October and on two other dates.

Wisconsin Radiological Society
Secretary, Dr. W. W. Moir, 309 Geele Ave., Sheboygan, Wis. Special meetings held during year; annual meeting each spring at Madison, Wis.

X-Ray Study Club of San Francisco
Secretary, Dr. Wm. W. Saunders, Veterans Administration Hospital, San Francisco 21, Calif. Meets monthly, third Thursday, at 7:45 P.M., Lane Hall, Stanford University Hospital.

Cuba, Mexico, Puerto Rico and Central America

Sociedad de Radiología y Fisioterapia de Cuba
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

Sociedad Mexicana de Radiologia y Fisioterapia
General Secretary, Dr. D. P. Cossio, Marsella No. 11, Mexico, D. F. Meets first Monday of each month.

Asociación Puertorriqueña de Radiología
Secretary, Dr. Rafael A. Blanes, Ave. Ponce de Leon 1175, Santurce, P. R.

Sociedad Radiológica Panameña
Secretary, Dr. L. Arrieta Sanchez, Apartado No. 86, Panama, R. de P. Meets monthly in a department of radiology of a local hospital, chosen at preceding meeting.

British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Ordinary meeting, on the Thursday preceding the third Friday, October to May at 8:15 P.M.
Medical Members' meeting, on third Friday in each month at 5:00 P.M., 32 Welbeck St., London, W 1.

Faculty of Radiologists
Honorary Secretary, Dr. J. F. Bromley, 45, Lincoln's Inn Fields, London, W.C.2, England.

Section of Radiology of the Royal Society of Medicine (Confined to Medical Members)
Meets third Friday each month at 4:45 P.M. at the Royal Society of Medicine, 1 Wimpole St., London.

Canadian Association of Radiologists
Honorary Secretary-Treasurer, Dr. D. L. McRae, Suite 305, 1555 Summerhill Avenue, Montreal 25, Que. Meetings January and June.

Section of Radiology, Canadian Medical Association
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

Société Canadienne-Française d'Electrologie et de Radiologie Médicales
Secretary, Dr. Origéne Dufresne, 4120 Ontario St., East, Montreal, P. Q.

College of Radiologists (Australia and New Zealand)
Honorary Secretary, Dr. Alan R. Colwell, c/o British Medical Agency, 135 Macquarie St., Sydney, N.S.W.

South America

Asociacion Argentina de Radiologia
Secretary, Dr. Lidio G. Mocsa, Avda. Gral. Paz 151, Córdoba, Argentina. Meetings held monthly.

Sociedad Argentina de Radiologia, Junta Central, Buenos Aires
Secretary, Dr. Oscar F. Noguera, Santa Fe 1171, Buenos Aires. Meetings are held monthly.

Sociedad Argentina de Radiologia, Filial del Litoral, Sede, Rosario
President, Dr. Francisco P. Cifarelli. Meets monthly second Wednesday, 19 ha 663 Italia St., Rosario, Santa Fe.

Sociedad Argentina de Radiologia, Filial del Sur, Sede, La Plata
President, Prof. Dr. Jose P. Uslenghi, La Plata. Meets monthly.

Sociedad Argentina de Radiologia, Filial del Centro Sede, Cordoba
President, Prof. Dr. David L. Caro, Corro 86, Cordoba. Meets monthly.

Sociedad Argentina de Radiologia, Filial del Norte, Sede, Tucuman
President, Dr. Julio Mendez Valladares, Rivadavia 358, Tucuman. Meets monthly.

Sociedad Argentina de Radiologia, Filial de Cuyo Sede, Mendoza.
President, Dr. J. A. Orfila, Hospital Central, Mendoza. Meets monthly.

SOCIEDADE BRASILEIRA DE RADIOLOGIA MEDICA
Secretary, Dr. Nicola Caminha, Av. Mem de Sa, Rio de Janeiro, Brazil. Meets monthly, except during January, February and March.

SOCIEDADE BRASILEIRA DE RADIOTERAPIA
Secretary, Dr. Oscar Rocha von Pfuhl, Av. Brigadeiro Luiz Antonio, 644 São Paulo, Brazil. Meets monthly on second Wednesday at 9:00 P.M. in São Paulo at Av. Brigadeiro Luiz Antonio, 644.

SOCIEDAD COLOMBIANA DE RADIOLOGIA
Secretary, Dr. Luis E. Lozano B., Carrera 12 No. 20–69, 6° piso, Bogota, Colombia. Meets last Thursday of each month.

SOCIEDAD PERUANA DE RADIOLOGIA
Secretary, Dr. Julio Bedoya Paredes, Apartado 2306, Lima, Peru. Meets monthly except during January, February and March, at Asociación Médica Peruana "Daniel A. Carrión," Villalta, 218, Lima.

SOCIEDAD DE RADIOLOGICA, CANCEROLOGIA Y FISICA MEDICA DEL URUGUAY
Secretary, Dr. Arias Bellini, Av. Agraciada 1464, Piso 13, Montevideo, Uruguay.

CONTINENTAL EUROPE

SOCIÉTÉ BELGE DE RADIOLOGIE
General Secretary, Dr. S. Masy, 111 Avenue des Allies, Louvain, Belgium. Meets monthly, second Sunday at Maison des Médecins, Brussels.

SOCIÉTÉ FRANÇAISE D'ELECTRO-RADIOLOGIE MÉDICALE, and its branches: SOCIÉTÉ DU SUD-OUEST, DU LITTORAL MÉDITERRANÉEN, DU CENTRE ET DU LYONNAIS, DE L'OUEST, DE L'EST, ET D'ALGER ET D'AFRIQUE DU NORD
Secretary-General, Dr. A. Dariaux, 9 bis, Boulevard Rochechouart, Paris IX°, France.

CESKOSLOVENSK SPOLEČNOST PRO RËNTGENOLOGII A RADIOLOGII V PRAZE
Secretary, Dr. Roman Bláha, Praha XII, stát. nemocnice, Czechoslovakia. Meets monthly except during July, August, and September. Annual general meeting.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland.

GDANSK SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. A. Smigielska, Akademia Lekarska, Gdansk. Meets monthly last Sunday at 10:30, X-Ray Dept., Akademia Gdansk.

WROCŁAW SECTION POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. R. Marciniak, Akad. Medyczna Wrocław, 68 Curie-Skłodowska St., Wrocław, Poland. Meets first Sunday of each month, X-Ray Department, Akademia Medyczna Wrocław.

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
Secretary, Dr. Oscar Meller, Str. Banual Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD
USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

SOCIEDAD ESPANOLA DE RADIOLOGIA Y ELECTROLOGIA
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT (SOCIÉTÉ SUISSE DE RADIOLOGIE)
Secretary, Dr. Max Hopf, Effingerstrasse 47, Bern, Switzerland.

DEUTSCHE ROENTGEN-GESELLSCHAFT
Secretary, Dr. Peter Kröker, (22a) Essen-Helsingen, Westpreussenstrasse 21. Meets annually in different towns.

SOCIETA ITALIANA DI RADIOLOGIA MEDICA
Secretary, Prof. Mario Ponzio, Ospedale Mauriziano. Torino, Italy. Meets biannually.

INDIA

INDIAN RADIOLOGICAL ASSOCIATION
Secretary, Dr. R. F. Sethna, Navsari Building, Hornby Road, Bombay 1, India.

SCIENTIFIC EXHIBIT

The Scientific Exhibit at the Fifty-fourth Annual Meeting of the American Roentgen Ray Society held at the Netherland Plaza Hotel, Cincinnati, Ohio, September 29–October 2, 1953, which was arranged by the Committee on Scientific Exhibits under the chairmanship of Dr. William A. Evans, Jr. was an excellent one and attracted much attention. The exhibits were placed in the spacious South Hall of the Netherland Plaza within convenient distance of the meeting room and all the other activities of the meeting. By the arrangement used this year of having all the papers read in the morning, ample time was available for visiting the exhibits, and the members and guests of the Society took good advantage of this convenient arrangement. Consequently the exhibits were well attended throughout the entire duration of the meeting and the exhibitors have been amply rewarded by the great interest shown. All of the exhibits were of excellent quality and the Committee on Awards must have had the greatest difficulty in choosing those for the customarily given prizes. This is shown by the fact that the number of awards distributed this year exceeded that of former years.

Following are brief descriptions of the exhibits together with the awards which were made:

Xeroradiography. John F. Roach, A.B., M.D., and Herman E. Hilleboe, B.S., M.D., M.P.H., Albany Medical College and New York State Deaprtment of Health, Albany, New York. Xeroradiography is a new method of recording a roentgen image. It is a totally dry procedure, requiring no darkroom processing and is sufficiently rapid to permit viewing of the finished "xeroradiograph" within one minute after the roentgen exposure is completed. It utilizes the unusual photoconductive properties of selenium, one of the semiconductors. The roentgen image is obtained in the following manner: A "xeroradiographic plate," a sheet of metal on which has been evaporated a thin layer of selenium, is placed in a high voltage mechanism which deposits on the surface of the selenium a positive charge. The plate is then exposed to radiation. Wherever roentgen rays strike the selenium, photoconduction occurs and the positive charge on the selenium at any given point is dissipated into the metal base plate in proportion to the quantity of radiation striking that point. Thus, at the completion of the exposure a positive electrostatic image remains on the plate. The plate is then sprayed with a finely divided, negatively charged powder, which selectively adheres to the charged areas and produces a visible image. One views and interprets this image directly or makes a permanent record by transfering the image to paper. After the xeroplate has served its purpose, its surface is cleaned by brushing off the powder and the plate is then ready for re-charging and re-use.

Radiographic speed, contrast, and resolving power are all within the range of currently used roentgen film.

The exhibit consisted of the various equipment used in connection with this procedure as well as a number of xeroradiographs and permanent paper reproductions of these. This exhibit was awarded the Silver Medal.

Disease of the Mitral Valve: Diagnosis and Surgical Treatment. T. F. Dry, M.D., R. L. Parker, M.D., G. W. Daugherty, M.D., J. E. Edwards, M.D., J. W. Kirklin, M.D., R. D. Pruitt, M.D., C. H. Schiefley, M.D., A. J. Bruwer, M.D., R. G. Tompkins, M.D., and A. H. Bulbulian, D.D.S., Mayo Clinic and Mayo Foundation, Rochester, Minnesota. Surgical treatment of mitral stenosis has been accepted as a standard procedure. Introduction of such physiologic methods as cardiac catheterization has contributed not only to more accurate diagnosis, but has added greatly to the understanding of the disturbed hemodynamics in mitral stenosis. This exhibit was a demonstration of (1) normal and abnormal mitral valves —stenotic, insufficient, etc.; (2) physiologic data obtained by means of cardiac catheterization in mitral heart disease; (3) clinical course, diagnostic features, and the differential diagnosis of mitral heart disease; (4) indications for surgery in patients with mitral stenosis and technique of surgical treatment—commissurotomy—together with postoperative results. This exhibit was awarded the Bronze Medal.

Clinical and Roentgen Studies in Sprue. Richard H. Marshak, B.S., M. A., M.D., Bernard S. Wolf, B.S., M.D., and David Adlersberg, M.D., Mt. Sinai Hospital, New York, New York. Serial roentgenological observations were

made in a group of 45 patients with primary sprue, over a period of several years. In 80 per cent of the cases a characteristic pattern consisting of moderate to marked dilatation of the mid- and distal jejunum, increased secretions, late segmentation, and thickening of the folds were noted. In 10 per cent of the cases the classical pattern previously described in sprue was noted. There was immediate marked and persistent segmentation, moderate dilatation of the segments of the small intestine and increased secretions. In 2 patients the pattern was normal. Films and charts showing these changes were demonstrated. The response of the sprue pattern in the small intestine to various forms of therapy, including cortisone, was shown. The clinical characteristics, management of sprue, and differential diagnosis was demonstrated. This exhibit was awarded a Certificate of Merit.

Bronchography in Infants and Children. Charles F. Ferguson, M.D., and Edward B. D. Neuhauser, M.D., The Children's Medical Center, Boston, Massachusetts. This exhibit illustrated (1) the quick tracheographic technique and (2) the routine bronchographic technique as employed at the Children's Medical Center to assist in the diagnosis of obstructions to the airway. Representative roentgenograms of the various anomalies of the aortic arch and great vessels, tracheoesophageal fistula without atresia, agenesis of the lung and other tracheobronchial anomalies, various causes of bronchiectasis and other types of bronchial conditions in infants were demonstrated. This exhibit was awarded a Certificate of Merit.

Detection of Concealed Thyroid Disease by Tracer Technique. Lawrence Reynolds, M.D., K. E. Corrigan, Ph.D., and H. S. Hayden, Ph.D., Harper Hospital, Detroit, Michigan. The exhibit illustrated the "life cycle" of the toxic thyroid adenomas. These influence the course of other clinical entities, particularly cardiac disease, diabetes mellitus, and some metabolic diseases of children. A few cases of Legg-Perthes' disease were shown. This exhibit was awarded a Certificate of Merit.

Therapeutic Experiences with High Energy Electrons (19.6 Mev). Lewis L. Haas, M.D., Roger A. Harvey, M.D., University of Illinois, College of Medicine, Chicago, Illinois; and John S. Laughlin, Ph.D., Memorial Hospital, New York, New York. High energy electrons (up to 22 mev.) have been extracted from the betatron and have been applied for medical therapy up to 19.6 mev. The electrons in this high energy range can be used for deeper seated lesions than previously available lower energy sources of electrons could reach. Lesions up to 8 cm. depth at this energy can be treated from a single port, or deeper by using opposite ports. The principles, indications, and reactions from electron radiations were demonstrated. Therapeutic effects were followed with Kodachrome transparencies. Examples were included illustrating the results obtained in cancer of the skin, tumors of the parotid gland, breast carcinoma, tumors of the maxillary antrum, carcinoma of the tonsil, and metastatic malignancy of the lymph nodes. This exhibit was awarded a Certificate of Merit.

A Library of Teaching Films (Construction and Operation). F. J. Hodges, M.D., and F. J. Hodges, III, M.D., University of Michigan, Ann Arbor, Michigan. This exhibit illustrated an accurate method for cataloging filing, and preserving in accessible form current films of value in teaching. The arrangement of the library and its operation were demonstrated. This exhibit was awarded a Certificate of Merit.

Venographic Clues as to Localization of Intracranial Masses. Paul A. Riemenschneider, M.D. and Arthur D. Ecker, M.D., State University of New York, Upstate Medical Center, Syracuse, New York. The displacement of cerebral veins as demonstrated by angiography has been little emphasized, particularly in the American literature. At times the alteration in venous pattern provides the major clues as to localization and frequently important evidence as to the extent of intracranial masses. This is particularly true of the deeper lesions where major arterial displacement is frequently minimal and difficult to evaluate. Recognition of the patterns of venous displacement further enlarges the useful scope of the angiographic method. This exhibit consisted of angiograms and schematic diagrams illustrating various types of displacement as drawn from a series of 600 examinations.

Myxoma of the Atrium: Roentgen Diagnosis During Life. Israel Steinberg, M.D., and William Dubilier, Jr., M.D., New York Hospital, Cornell Medical Center, New York, New York. Angiocardiography has made possible the recognition of intracardiac tumors during life. Two cases of myxoma of the left atrium were presented. These represent the first antemortem demonstration of such lesions.

Physiological Bronchography. Charles A. Priviteri, M.D., Veterans Administration Hos-

pital, Buffalo, New York. Bronchography, as outlined in the exhibit, is performed by the use of two physiological principles, namely, inspiration and increased intrathoracic pressure. Lipiodol is pooled in one main bronchus and then, by requesting the patient to take a forced deep inspiration, followed subsequently by rotating the patient from the supine to the prone position, the oil is distributed throughout the bronchial tree. This method is simple and seems to demonstrate more adequately than any previously devised method, the complete arborization of the bronchial structures. The exhibit consisted of the minute details of the examination such as instructions to the patient and the procedure of lipoidol instillation. Roentgenograms were shown demonstrating the various types of pulmonary pathology which it is possible to demonstrate with the bronchographic studies. The study was based on seventy-two examinations performed in 46 patients. The pathologic findings in the seventy-two examinations were presented in tabular form.

Metastatic Disease of the Lung. Robert C. Pendergrass, M.D., American Tumor Clinic, Americus, Georgia. The detection of pulmonary metastases in patients having primary malignant tumors elsewhere is very important in planning treatment, in establishing prognosis and in guiding discussion of the problem of the cancer patient. Pulmonary metastases assume roentgen patterns which may be grouped as follows: (1) pleural thickening and effusion; (2) linear infiltrations; (3) annular lesions; (4) miliary seedings; (5) localized atelectasis or emphysema; (6) hilar adenopathy. Pericardial effusion may also be encountered. This exhibit illustrated examples of pulmonary metastases from a variety of primary malignant lesions, including several cases of pulmonary metastases from primary carcinoma of the cervix uteri. Benign pulmonary lesions which might be confused with metastases were also shown.

Roentgen Manifestations of Necrotizing Granulomatosis and Angiitis of the Lungs. Daniel Kornblum, M.D., and Robert Fienberg, M.D., Veterans Administration Hospital, Boston, Massachusetts. There has appeared with increasing frequency in the literature reports of a complex of granulomatosis with angiitis of the lungs, massive necrosis of the spleen and focal granulomatous glomerulonephritis. In these cases, which have received many interpretations and diagnoses because of their varied manifestations, there has been only sparse mention of the roentgen appearance. The roentgenographic as well as the clinical and pathological features were presented in this exhibit.

Roentgenology of Breast Disease. J. Gershon-Cohen, M.D., M.S., and Helen Ingleby, M.B., M.R.C.P., Albert Einstein Medical Center, Philadelphia, Pennsylvania. This exhibit consisted of a series of transparencies of roentgenograms, photographs of gross specimens and photomicrographs illustrating the value of the roentgen examination in the study of various breast disorders.

Results of Cortisone Treatment in Boeck's Sarcoid. I. R. Berger, M.D., and Max Michael, Jr., M.D., Veterans Administration Hospital, Atlanta, Georgia. This exhibit was based upon a clinical and roentgen study of 12 patients with pulmonary manifestations of Boeck's sarcoid. The clinical contribution of cortisone therapy, its immediate roentgen effects and the pulmonary changes following therapy were presented and discussed. Representative cases with purely pulmonary, pulmonary and mediastinal, and mediastinal involvement were described and illustrated. Follow-up in most cases is of the order of three years.

The Gastric Rugal Pattern. Lawrence A. Davis, M.D., Peter K. Knoefel, M.D., and Everett L. Pirkey, M.D., University of Louisville, Louisville, Kentucky. Various factors affecting the visualization of the gastric rugal pattern were presented, based on fifty-two observations in 102 subjects (77 males and 25 females). Tables and beautiful illustrations depicted the influence of the body type of the patient, amount and composition of the resting gastric secretion, as well as of the particle size and chemical composition of the opaque medium.

Roentgen Demonstration of Tendon and Bursal Calcification. Henry J. Woloshin, M.D., and John A. Kirkpatrick Jr., M.D., Temple University Medical School and Hospital, Philadelphia, Pennsylvania. The demonstration of calcification in the region of tendon insertion or origin, or in bursae, often confirms the clinical diagnosis of tendonitis or bursitis. The specific tendon or bursa involved may be recognized in many cases. In this study cadaver material has been used in demonstrating specific tendons and bursae. The material has been correlated with cases from the files of the Department of Pathology of Temple University Hospital.

Nephrotomography. John A. Evans, M.D., William Dubilier, Jr., M.D., and James C.

Monteith, M.D., New York Hospital, Cornell Medical Center, New York, New York. Nephrotomography is a combination of rapid intravenous nephrography and laminagraphy. It provides precise delineation of functioning renal parenchyma and has been found to be of considerable value in the differentiation of cysts from neoplasms. Nephrotomography supplements but does not supplant accepted urographic techniques. It provides more precise diagnosis in many cases in which routine examinations are indecisive. The exhibit consisted of explanatory charts and nephrotomograms illustrating the advantages of this type of study.

An Improved Method by X-Ray Reproduction and Duplication. Robert W. Carlin, sponsored by Dr. B. S. Wolf and Dr. R. H. Marshak, Mt. Sinai Hospital, New York, New York. A method was demonstrated, step-by-step, for duplication and reproduction of roentgenograms, by means of density equalizing masks. This method is applicable to normal roentgenograms, but its chief value consists in its ability to improve technically poor films. In addition to the procedure, a number of films were shown, demonstrating the original and then the final results.

Resilient Plastic Replicas of Surgical Pathology and Their Clinical Application. Clemmer M. Peck, M.D., Forrest V. Schumacher, M.D., Aubrey O. Hampton, M.D., Radiological Clinics of Drs. Groover, Christie and Merritt, Washington, D. C.; and John V. Niiranen, CMDR. (D.C.) U.S.N., D.D.S., Naval Dental School, National Naval Medical Center, Bethesda, Maryland. This exhibit was composed of two parts: the first part illustrated a new method of reproducing surgical pathological specimens in resilient plastic. The second part demonstrated a clinical application with plastic models. This clinical application consisted of a complete interpretation of the gross pathology of gastric ulcerations with particular attention directed to the margin of the ulcer in the profile view. Disappearance of the margin tends to indicate healing of the ulcer. The exhibit included many roentgenograms illustrating the various types of gastric lesions and Kodachrome photographs of the operative specimen as well as the plastic replicas of the surgical specimen.

Isodose Curves for Intracavity Therapy. E. Dale Trout, B.S., Sc.D., John P. Kelley, B.S., and Arthur C. Lucas, Milwaukee, Wisconsin. This exhibit consisted of a display of isodose curves for intracavity therapy for half-value layers of 0.5, 1, 2 and 3 mm. Cu. Data have been taken and plotted for these half-value layers using the three types of specula in general use; namely, a periscopic device with metal cones providing fields of 2 to 5 cm., a bakelite speculum permitting the spread of radiation through the speculum wall, and the expanding metal speculum of Erskine providing a rectangular field. This exhibit was awarded a Certificate of Merit.

The Mount Sinai Hospital Colpostat. Sidney M. Silverstone, M.D., The Mount Sinai Hospital, New York, New York. The design of the Mount Sinai Hospital colpostat permits accurate placement of radium in the lateral fornices of the vaginal vault by means of two ovoids maintained in position by a central locking device. When the position of the radium capsules is known relative to the anatomical structures a calculation of dose can be made at any point in the pelvis. For the analysis of dosage in cancer of the cervix uteri, six representative points were chosen for the calculation. The construction and application of the colpostat were shown. Typical dose calculations and isodose contours were illustrated.

The Radioisotope. United States Atomic Energy Commission, Oak Ridge, Tennessee. "The Radioisotope" consisted of a series of training films on radioisotope handling and utilization prepared for the Armed Forces Institute of Pathology by the United States Signal Corps Photographic Center under the technical direction of the United States Atomic Energy Commission, Oak Ridge, Tennessee and contractor laboratories. This series of cinematographic films has the object of teaching radioisotope techniques and orienting the scientist in the manifold ways of the use of the radioisotopes. The following were presented under their classified serial numbers: No. 1: Fundamentals of radioactivity; No. 2: Properties of radiation; No. 3: Practical procedures of measurement; No. 4: Methodology; No. 5: Principles of radiological safety; No. 6: Practice of radiological safety; No. 12: Agricultural research; No. 13: General sciences.

These films are available for educational institutions, industry, medical societies and institutions, etc.

The Use of Radioactive Colloidal Gold (Au-198) in Pleural Effusions and Ascites Associated with Malignancy. Plasma Volume and Blood Volume Studies; a Comparison of Avail-

able Techniques. Department of Radiology, U. S. Naval Hospital, National Naval Medical Center, Bethesda, Maryland. Radioactive gold is being used in treatment of complications of certain cancers. Radioactive colloidal gold can be injected into the pleural and abdominal spaces for treatment of cancer of the pleura and peritoneum complicated by fluid production. Because of its large molecular size it remains at the site of injection and is not picked up by the blood stream. Clinical results with radioactive colloidal gold representing 22 cases were presented in the exhibit. The exhibit consisted of roentgenograms of the chest showing the presence of pleural effusion both before, during and after therapy with colloidal gold. It also indicated in a number of charts the therapeutic use of intracavity radiogold and the results obtained in different types of tumors producing pleural effusions as well as abdominal ascites.

The second part of the exhibit consisted of additional charts giving the use of radioisotopes in body fluid measurements. Studies are under way utilizing radioactive isotope tagged blood elements. When perfected these methods will be used to evaluate various plasma space expanders and blood substitutes.

Educational Exhibit. The American Society of X-Ray Technicians, Fond du lac, Wisconsin. The aim and purpose of this exhibit was to show what the American Society of X-Ray Technicians has done, what they hope to do, and how they plan to do it. The exhibit consisted of various charts dealing with the distribution of training schools for x-ray technicians, the larger objectives of the American Society of X-Ray Technicians, with various pamphlets which were distributed at the exhibit dealing with training of x-ray technicians and the value of such training.

COMMERCIAL EXHIBIT

The Commercial Exhibit at the Fifty-fourth Annual Meeting of the American Roentgen Ray Society held at the Netherland Plaza, Cincinnati, Ohio, September 29 to October 2, 1953, equalled or exceeded the standard which the Society has come to expect from its exhibitors. Much thought had gone into the preparation and planning of the exhibits and the over-all arrangement was a most pleasing one. The exhibits were located in the Hall of Mirrors, the third floor Foyer, and the North Hall, all of these locations being accessible to the meeting room, the Scientific Exhibits and the Instruction Courses. The exhibit was a varied one and included not only much equipment new in design but also improvements and more flexible adaptation of the older types of equipment. The Society wishes to thank the various exhibitors for their part in making the Cincinnati meeting a most successful one. The extent and scope of the exhibits can be ascertained by a perusal of the following list of exhibitors:

Amperex Electronic Corporation, Brooklyn, New York; *Ansco*, Binghamton, New York; *Automatic Seriograph Corporation*, College Park, Maryland; *Bar-Ray Products, Inc.*, Brooklyn, New York; *Bell-Craig, Inc.*, New York, New York; *Blair X-Ray*, Los Angeles, California; *Buck X-Ograph Company*, St. Louis, Missouri; *C & P Specialties, Inc.*, Indianapolis, Indiana; *E. I. du Pont de Nemours & Company, Inc.*, Wilmington, Delaware; *Eastman Kodak Company*, Rochester, New York; *Eureka X-Ray Tube Corporation*, Chicago, Illinois; *E. Fougera & Company, Inc.*, New York, New York; *Franklin X-Ray Corporation*, Philadelphia, Pennsylvania; *General Electric Company*, Schenectady, New York; *General Electric Company, X-Ray Department*, Milwaukee, Wisconsin; *Grune & Stratton, Inc.*, New York, New York; *Halsey X-Ray Products, Inc.*, Brooklyn, New York; *Hard and Company, Inc.*, Ann Arbor, Michigan; *Paul B. Hoeber, Inc.*, New York, New York; *Keleket X-Ray Corporation*, Covington, Kentucky; *Lea & Febiger*, Philadelphia, Pennsylvania; *Liberty Dressing Co.*, Gloversville, New York; *Liebel-Flarsheim Company*, Cincinnati, Ohio; *Machlett Laboratories, Incorporated*, Springdale, Connecticut; *F. Mattern Manufacturing Company*, Chicago, Illinois; *Micro X-Ray Recorder, Inc.*, Chicago, Illinois; *North American Philips Co., Inc.*, Mt. Vernon, New York; *Nuclear Research and Development Co.*, St. Louis, Missouri; *Ortho Pharmaceutical Corporation*, Raritan, New Jersey; *Pako Corporation*, Minneapolis, Minnesota; *Picker X-Ray Corporation*, White Plains, New York; *Professional Equipment Company*, Maywood, Illinois; *Schering Corporation*, Bloomfield, New Jersey; *Frank Scholz X-Ray Corporation*, Boston, Massachusetts; *Standard X-Ray Company*, Chicago, Illinois; *Charles C Thomas, Publisher*, Springfield, Illinois; *United States Radium Corporation*, New York; *Victoreen Instrument Company*, Cleveland, Ohio; *Visi-Shelf File Incorporated*, New York, New York; *Westinghouse Electric Corporation*, Pittsburgh, Pennsyl-

vania; *Wilmot Castle Company*, Rochester, New York; *Winthrop Stearns, Inc.*, New York, New York.

NEW OFFICERS OF THE AMERICAN ROENTGEN RAY SOCIETY

At the Fifty-fourth Annual Meeting of the American Roentgen Ray Society held at the Netherland Plaza, Cincinnati, Ohio, September 29 to October 2, 1953, the following officers were elected for the year 1953–1954: *President-Elect*: Dr. Joshua C. Dickinson, Tampa, Florida; *1st Vice-President*: Dr. Wilbur Bailey, Los Angeles, California; *2nd Vice-President*: Dr. David G. Pugh, Rochester, Minnesota; *Secretary*: Dr. Barton R. Young, Philadelphai, Pennsylvania (re-elected); *Treasurer*: Dr. Wendell G. Scott, St. Louis, Missouri (re-elected); *Member of the Executive Council*: Dr. Harold O. Peterson, St. Paul, Minnesota. The *President* is Dr. Harry M. Weber, Rochester, Minnesota, and the *Chairman of the Executive Council* is Dr. Paul C. Hodges, Chicago, Illinois.

CANCER SEMINAR

The Arizona Division, American Cancer Society, is holding a Cancer Seminar on January 14, 15 and 16, 1954, at Phoenix, Arizona. All sessions will be held at Paradise Inn, Phoenix, and delegates will be housed at Paradise Inn and other resort hotels of the area. The following is the tentative program which has been arranged:

January 14, 1954

9:30 A.M. Recent Advances in Cancer Therapy (Chemotherapy, Radiation and Radioisotopes). Panel Members: Paul C. Aebersold, Ph.D., Michael DeBakey, M.D., L. H. Garland, M.D., Joe V. Meigs, M.D., Orvar Swenson, M.D. Moderator: Edward M. Hayden, M.D.

11:00 A.M. Neoplasms of the Central Nervous System. Panel Members: Percival Bailey, M.D., E. S. Gurdjian, M.D., Eugene P. Pendergrass, M.D. Moderator: John R. Green, M.D.

2:00 P.M. Carcinoma of the Cervix. Panel Members: O. A. Brines, M. D., Joe V. Meigs, M.D., L. H. Garland, M.D. Moderator: Preston H. Brown, M.D.

3:30 P.M. Carcinoma of the Breast. Panel Members: Michael DeBakey, M.D., O. A. Brines, M.D., Anthony Curreri, M.D., Eugene P. Pendergrass, M.D. Moderator: Douglas Gain, M.D.

January 15, 1954

9:30 A.M. Exfoliative Cytology. Panel Members: L. H. Garland, M.D., Joe V. Meigs, M.D., David A. Wood, M.D. Moderator: O. O. Williams, M.D.

10:00 A.M. Surgical Methods for Relief of Intractable Pain. Panel Members: Percival Bailey, M.D., E. S. Gurdjian, M.D., Eugene P. Pendergrass, M.D. Moderator John A. Eisenbeiss, M.D.

2:00 P.M. Carcinoma of the Lung. Panel Members: Michael DeBakey, M.D., Anthony Curreri, M.D., Eugene P. Pendergrass, M.D., David A. Wood, M.D. Moderator: D. W. Melick, M.D.

3:30 P.M. Trends in Cancer Research. Panel Members: To be presented by Dr. Cameron. Moderator: Charles S. Cameron, M.D.

January 16, 1954

10:00 A.M. Leukemia and Lymphomas. Panel Members: L. H. Garland, M.D., Orvar Swenson, M.D., David A. Wood, M.D. Moderator: Ralph Fuller, M.D.

11:30 A.M. Tumors of Childhood. Panel Members: O. A. Brines, M.D., L. H. Garland, M.D., Orvar Swenson, M.D. Moderator: Hugh Thompson, M.D.

THE BRITISH INSTITUTE OF RADIOLOGY ANNUAL CONGRESS AND EXHIBITION

The Annual Congress of the British Institute of Radiology is to take place on December 10 and 11, 1953, at the Caxton Hall, Victoria Street, London, S.W.I.

An interesting scientific program and a scientific exhibition if the form of roentgenograms and pictorial or photographic material have been arranged.

The Mackenzie Davidson Memorial Lecture is to be given on the evening of the first day and a dinner will be held on the evening of the second day.

Attendance at any part of the Congress, other than the Memorial Lecture, is restricted to those who have applied for registration as members of the Annual Congress. The fee for such registration is 10s/6d. for members of the Institure and £1.1s. for non-members. Registration forms may be obtained on application to the General Secretary, The British Institute of Radiology, 32 Welbeck Street, London, W.1.

NORTH CAROLINA RADIOLOGICAL SOCIETY

At a recent meeting, the following were elected to office in the North Carolina Radio-

logical Society: *President*, Dr. Luther W. F. Oehlbeck; *President-Elect*, Dr. Ivan E. Brouse; *Vice-President*, Dr. Thomas Worth; *Secretary-Treasurer*, Dr. W. C. Sternbergh, Charlotte Memorial Hospital, Charlotte, N. C.

OREGON RADIOLOGICAL SOCIETY

At the annual meeting of the Oregon Radiological Society held on June 10, 1953, the following officers were elected: *President*, Dr. J. Richard Raines, Portland, Oregon; *Vice-President*, Dr. Clay A. Racely, Eugene, Oregon; *Secretary-Treasurer*, Dr. John Wayne Loomis, 919 Taylor St., Portland 5, Oregon.

TENNESSEE RADIOLOGICAL SOCIETY

At a recent meeting of the Tennessee Radiological Society which was held in conjunction with the State Medical Association in Memphis, Tennessee, on April 14, 1953, the following officers were elected for the coming year: *President*, Dr. Jos. McKinney Ivie, Nashville, Tennessee; *Vice-President*, Dr. J. Marsh Frere, Chattanooga, Tennessee; *Secretary-Treasurer*, Dr. George K. Henshall, 311 Medical Arts Building, Chattanooga 3, Tennessee.

Dr. Cesare Gianturco of Urbana, Illinois, was guest speaker and discussed "High Voltage Roentgenography in the Diagnosis of Colonic Polypi." Dr. Milton Adams of Memphis, Tennessee, also presented a discussion on "Late Radiation Sequelae."

WESTCHESTER RADIOLOGICAL SOCIETY

At a recent meeting of the Westchester Radiological Society, the following officers were elected for the coming year: *President*, Dr. Theodore West, Port Chester, N. Y.; *Treasurer*, Dr. Frederick H. Lutze, New Rochelle, N. Y.; *Secretary*, Dr. Charles G. Huntington, 170 Maple Avenue, White Plains, N.Y.

AMERICAN BOARD OF RADIOLOGY

The deadline for filing applications for the Spring, 1954, examination by the American Board of Radiology is December 1, 1953. The examination will be held during the week of April 25, 1954, in Cincinnati, Ohio.

B. R. Kirklin, M.D., *Secretary*
Mayo Clinic
Rochester, Minnesota

FELLOWSHIP IN PEDIATRIC ROENTGENOLOGY

Applications are now being accepted for the Fellowship in Pediatric Roentgenology at the Children's Hospital of Cincinnati. The fellowship will be available January 1, 1954, instead of July 1, 1954. Applicants are requested to submit a curriculum vitae and three letters of recommendation to Dr. Frederic N. Silverman, Director, Department of Roentgenology, Children's Hospital, Cincinnati 29, Ohio.

DR. ARCHER HONORED

At the meeting of the Medical Society of Virginia held at Roanoke, Virginia, October 18 to 21, 1953, Dr. Vincent W. Archer of Charlottesville was installed as President of the Society.

ABSTRACTS OF RADIOLOGICAL LITERATURE

Department Editor: T. LEUCUTIA, M.D., Harper Hospital, Detroit 1, Michigan

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ROENTGEN DIAGNOSIS

HEAD

LINDGREN, E., and DI CHIRO, G. The roentgenologic appearance of the aqueduct of Sylvius. *Acta radiol.*, Feb., 1953, *39*, 117–125.

The course and shape of the normal aqueduct of Sylvius are discussed on the basis of experience gained by the authors in the study of 300 encephalograms. The aqueduct showed a smooth arch in only 35 per cent of the cases; in 65 per cent it exhibited various degrees of angulation. They state that the aqueduct reaches as far as the quadrigeminal plate which forms its upper dorsal border and that the angle of the aqueduct appears to correspond with the border between the superior and inferior colliculi. In some cases the floor of the aqueduct has a smoothly curved course while the roof is angulated to a degree depending upon the shape of the quadrigeminal plate. In other cases the floor and roof run parallel, and there is a real kink—the kink of the normal aqueduct. The authors found no relationship between this kink and the shape of the skull.

The authors describe both indirect and direct methods of measuring the aqueduct based on anatomical landmarks. The indirect method gave a length of 1.6 to 1.8 cm., and the direct method gave lengths of 1.7, 1.8, and 1.9 cm. The target distance in each instance was 70 cm.

In discussing the pathologic aqueduct, the authors state that the so-called pathologic kinking of the aqueduct in lesions of the posterior fossa is an accentuation of the normal appearance. Since the shape of the aqueduct is dependent upon the anatomic shape and position of the quadrigeminal plate, and this plate is rather resistant to pressure, the deformity sustained is small. In expanding lesions behind and beneath the quadrigeminal plate, the aqueduct becomes kinked at the weakest point (the border between the inferior and superior colliculi). In expanding lesions so situated that they only cause a widening of the fourth ventricle, the plate will turn backwards and upwards in its entirety, with or without retaining its normal angulation, and the aqueduct will be dilated. In tumors located high in the posterior fossa, the whole aqueduct will be displaced forwards. It is only in these circumstances that the kink is not found in its usual location in the middle part of the quadrigeminal plate but at the upper point of the plate at the border of the third ventricle. In tumors invading the quadrigeminal plate, the border of the aqueduct becomes irregularly thickened, and has a more vertical course. There is also a change in the dorsal part of the third ventricle.

Both normal and pathological kinking of the aqueduct are illustrated.—*William H. Smith, M.D.*

BULL, JAMES. The radiological diagnosis of intracranial tumours in children. *J. Faculty of Radiologists*, Jan., 1953, *4*, 149–170.

Intracranial tumors are the commonest of all tumors seen in children. Posterior fossa tumors are the most frequent, while meningiomas, pituitary tumors and acoustic neurinomas are rare. It is now realized that the most careful clinical examination and the most astute interpretation of the history and physical signs often fail to provide an accurate localization of an intracranial tumor. Of all other methods of investigation, roentgenologic examination is the most important.

In any child suspected of having an intracranial tumor, the plain roentgen examination should be regarded as part of the initial clinical study. The most important signs are: (1) suture diastasis, which may be minimal and yet of significance; (2) decalcification, with or without erosion, of part of the sella, most commonly the dorsum.

The author analyzed 190 cases of intracranial tumors. Of these, 66 were supratentorial: 41 in the cerebral hemispheres, 18 in Rathke's pouch, 3 involving the pituitary, and 4 in the orbit. There were 9 mid-brain tumors. The remaining 115 were infratentorial: 25 were in the pons and medulla, 84 in the cerebellum, 4th ventricle and vermis, and 6 were elsewhere in the posterior fossa. Calcification was found in 17 out of 18 Rathke pouch tumors, and in 20 out of 41 cerebral hemisphere lesions. All others were noncalcified.

In 59 out of 66 supratentorial tumors, or in over 89 per cent, plain roentgenograms revealed evidence of a space-taking lesion. Formerly, tuberculomas were considered very common intracranial space-occupying lesions. The author has seen only 2 confirmed calcified tuberculomas of the brain in patients of any age group and he thinks this should be one of the last rather than the first diagnosis to come to mind in countries where tuberculosis is not widespread.

Of the 9 mid-brain or para-third ventricle tumors none was calcified. Consequently demonstration was impossible by plain films. Ventriculography gave accurate localization in all cases.

Extracerebral posterior fossa tumors are rare in children. In this series there were 4 dermoids, 1 eighth nerve neurofibroma and 1 meningioma. In contrast, there were 109 *intracerebral* tumors. It is interesting that not one of these tumors was calcified so that here we have to rely entirely on contrast methods for topographical localization. Bull thinks that arteriography is not very helpful in these lesions, with the exception of the uncommon hemangioblastomas. Pneumography is the method of choice, supplemented sometimes by positive contrast ventriculography. Ventriculography is generally preferred to encephalography.

The chief sites to consider in posterior fossa tumors in children are: (1) pons: anterior to the aqueduct and

fourth ventricle,—the roentgenological landmarks; (2) cerebellar hemispheres; (3) between the hemispheres in the midline: posterior to the aqueduct and fourth ventricle. Two important nontumorous conditions must be differentiated: (a) aqueduct stenosis; (b) obstruction of the exit foramina of the fourth ventricle.

The most important posterior fossa tumors are the astrocytomas, in that they are eminently amenable to surgery. There were 41 astrocytomas in the posterior fossa, 85 per cent being in children under ten years of age. Suture diastasis was present in all but 3 cases. Medulloblastomas are almost as common as astrocytomas, 33 cases being seen in this series. As in the astrocytomas, 85 per cent were in children under ten years of age.

In differential diagnosis, abscess is probably the most common space-taking lesion next to tumor. Subdural hematomas and hygromas are not uncommon. Stenosis of the aqueduct of Sylvius must always be borne in mind as differentiation by clinical means may be impossible.—*Samuel G. Henderson, M.D.*

Rand, Robert W., and Lemmen, Lloyd J. Tumors of the posterior portion of the third ventricle. *J. Neurosurg.*, Jan., 1953, *10*, 1–18.

The paper is based on 32 cases of tumors which originated in the posterior wall of the third ventricle or pineal gland. The predominating symptom was increased intracranial pressure with signs of involvement of the regional structures. The alterations in the ocular movements caused by the tumors are discussed and the anatomical explanation of the symptoms is reviewed.

In 7 of the patients pineal tumor was suspected because of the extensive calcification seen in the pineal gland in the plain roentgenogram of the skull. Five of these were less than fifteen years old. Calcification in the pineal gland in children less than ten years of age is highly suggestive of a pineal tumor. Ventriculography is the most dependable roentgenological procedure in diagnosing these lesions. The tumor usually obstructs the aqueduct of Sylvius and protrudes into the posterior portion of the third ventricle. The tumors in the anterior part of the third ventricle are due to either seeding from the original pineal gland tumor or ectopic primary pinealomas.

Direct surgical attack is not recommended because of the high mortality (70 per cent in 16 operated cases). Ventriculocisternostomy and third ventriculostomy followed by roentgen therapy is the treatment of choice at present. Of the 16 patients treated by the latter procedure, 9 are alive and well from two to ten years after treatment. Two of the 3 patients who had signs of seeding of the tumor to the leptomeninges died at nine and sixteen months after therapy. The authors believe that roentgen therapy should be started as soon as possible after the pressure-relieving operation. The dosage factors are given in the report. The conservative treatment not only offered a longer survival but a smaller neurological deficit.—*F. M. Windrow, M.D.*

Bassett, Robert C., Rogers, James S., Cherry, Glenn R., and Gruzhit, Carl. The effect of contrast media on the blood-brain-barrier. *J. Neurosurg.*, Jan., 1953, *10*, 38–47.

The authors employed the basic method of Broman and Olssen to demonstrate the breakdown of the blood-brain barrier. They used 35 per cent diodrast, 70 per cent diodrast, 70 per cent urokon, 35 per cent thorium dioxide colloidal solution, sodium iodide, and sodium chloride solutions of the same and greater tonicity as 35 per cent diodrast.

They determined that a disturbance in the cerebral vascular permeability was the basic lesion, and that concentration and time of exposure were of primary importance in estimating the extent of the lesion. Neither acute vascular spasm nor hemorrhage was observed. The lumen of the vessels decreased only about 10 per cent in size during the injections. The breakdown of the blood-brain barrier increased with increase in the amounts and concentration of the contrast media.

It was determined that anoxia played no part in producing the undesirable reactions of injection of the media. Sodium chloride solutions of the same concentration as the media produced much smaller effects on the vascular permeability.

The cerebrospinal fluid proteins increased approximately 40 per cent following injection of 35 per cent diodrast.

The fundamental lesion is thought to be an alteration of the endothelial capillary membrane and the changes are directly proportional to the concentration and quantity of the test substance in contact with the capillary endothelium and the time during which this concentration prevails. Repeated fractional doses have a cumulative effect. The presence of intrinsic arterial disease increases the undesirable effects of the contrast media.—*F. M. Windrow, M.D.*

Eggimann, P. Les tumeurs malignes des fosses nasales et de l'ethmoïde; étude radiologique; essai de classification topographique. (Malignant tumors of the nasal fossae and of the ethmoid; roentgen study; attempt at topographic classification.) *Radiol. clin.*, March, 1953, *22*, 65–96.

This study is based on a series of 154 cases of malignant tumors of the nasal cavity and of the ethmoid, including 28 cases of ethmomaxillary tumors, treated or examined at the Fondation Curie, Paris, between 1930 and 1950.

Anatomically, the nasal cavity is, as a rule, divided into an upper and lower compartment. The former comprises the olfactory grooves and the lateral masses of the ethmoid bone with the anterior and posterior cell labyrinths opening into the middle and superior meatuses respectively. Because of this, the middle meatus is included in the upper compartment of the nasal cavity although physiologically it belongs to the lower or respiratory compartment. The posterior border of the nasal cavity coincides with the plane of the choanae while the anterior part is delimited by a plane tangential to the frontal bone. Due to the intimate relationship of the anterior ethmoidal cells with the frontal sinus, on the one hand, and of the posterior ethmoidal cells with the sphenoid sinus, on the other, it is impossible to separate these two accessory sinuses when dealing with tumors of the upper compartment of the nasal cavity.

A microscopic examination was obtained in 122 of the 154 cases. The histopathologic findings are discussed in the light of the various classifications found in the literature and a comparative table is given listing the histopathologic classifications of Portmann and Retrouvey, Walther, Ringertz and of the author's. The influence of the microscopic appearance on the incidence of regional and distant metastases in the various types of tumors is also considered.

There is a great divergence of opinion as to the value of the roentgen examination in tumors of the nasal cavity and accessory sinuses. The author believes that much information can be gained when conventional roentgenographic methods in various positions are associated with laminagraphic studies. The incidences preferred are: (a) posteroanterior incidence, according to Stenhuis; (b) submentovertical incidence, according to Hirtz; and (c) lateral incidence, the central ray being directed 1.5 cm. in front of the tragus. Whenever necessary, lipiodal instillation is used.

The roentgen findings are analyzed in great detail. On the basis of these findings the author proposes, in association with Dr. Baclesse, the following topographic classification of the tumors of the upper compartment of the nasal cavity: (1) tumors of the anterior ethmoid, or ethmofrontal tumors, (2) tumors of the ethmoid proper; and (3) tumors of the posterior ethmoid, or ethmosphenoidal tumors. To these may be added (4) the ethmomaxillary tumors, the tumors of the maxillary sinus proper forming a separate group. It was possible to place in one of these four categories the tumors of 131 cases, including the tumors of the lower compartment in 16 cases. The distribution was: group 1, 5 cases; group 2, 81 cases; group 3, 17 cases; and group 4, 28 cases.

The end results are tabulated in: (1) 49 cases of tumors of the upper compartment, (2) 15 cases of ethmomaxillary tumors and (3) 14 cases of lymphosarcoma and reticulum cell sarcoma of both compartments. Only 4 patients survived five years or longer in the first group, 1 patient in the second group and 5 patients in the third group. The technique of roentgen irradiation devised by Baclesse is also described.

The article is richly illustrated with reproductions of roentgenograms and laminagrams.—*T. Leucutia, M.D.*

Curtin, J. McAuliffe. Hypertelorism. (Report of a case in a boy aged nine years.) *Irish J. M. Sc.*, March, 1953, *6*, 121–123.

The first case of this anomaly was described by Greig in 1914. Clinically, the condition is recognized by the appearance of the eyes which are placed far apart, by the flat nose, low forehead and prominent frontal eminences. Wilson is quoted as stating that a vague yet unmistakable impression of fetal physiognomy is conveyed by a glance at a typical case. The roentgenograms of the skull show large nasal apertures with great breadth of the cribriform plates. The great wings of the sphenoid are small and the small wings larger than normal.

The differential diagnosis from other cranial dysostosis is discussed.

The case presented by the author is that of a nine year old boy complaining of difficulty in vision with a normal mental development and doing well in school. The skull roentgenograms showed rather marked widening of the upper portions of the nasal passages without any development of the nasal process of the frontal bone.

Railly considers that there are four forms of the anomaly: (1) facies common to all; (2) facies and familial tendency, but without mental defect; (3) facies, no familial tendency, but with mental defect; and (4) facies, familial tendency with mental defect.

The author felt that his case fell into the group of a simple hypertelorism described by Pickerill as having the characteristic ocular far-apartness, no mental deficiency and no familial tendency, and no associated physical deformities. Pickerill operated on all patients, obtaining an improvement in the cosmetic appearance of their noses. The author proposes to improve the cosmetic appearance of the nose in his case by a similar operation.—*J. M. Dell, Jr., M.D.*

Hurter, K. Die Pneumatisationshemmung der Schädelnebenhöhlen als ein Zeichen von Disposition zu Bronchiektasen. (Arrested pneumatization of the accessory sinuses as a sign of disposition to bronchiectasis.) *Tuberkulosearzt*, Feb., 1953, *7*, 61–73.

In 1933 Kartagener described 4 cases presenting a triad of manifestations, calling attention to the frequency with which bronchiectasis and nasal sinus disease occur with transposition of the viscera. The simultaneous occurrence of these three conditions

has come to be called Kartagener's triad. The author has recently observed 3 patients who in addition to the usual findings of bronchiectasis, situs inversus viscerum totalis, and nasal sinus inflammation, showed arrested development of the frontal and mastoid sinuses. Limited development of the frontal sinus as an indication of hypoplasia of the paranasal sinuses in general has already been reported in connection with cases of true bronchiectasis alone and Kartagener's syndrome; the arrested mastoid pneumatization has not apparently been previously remarked upon, however.

There is a very close connection between arrested pneumatization of the accessory sinuses of the skull and true bronchiectasis. Their occurrence is on the same basis, namely the general "asthenia" of the respiratory mucosa. The inefficiency of this mucosa expresses itself in the underdevelopment of the ciliated epithelium and of the mucosal glands. It shows itself clinically as diminished resistance against banal infections such as colds, bronchitis, and sinusitis. It also results in arrested pneumatization of the accessory sinuses as seen roentgenologically. In cases of simple true bronchiectasis the author found pneumatization of the frontal sinus, mastoid, and mastoid process in 62, 46, and 70 per cent of cases respectively. In cases of Kartagener's triad the same structures were pneumatized in 68, 14, and 18 per cent respectively, indicating that while arrested development of the frontal sinuses is seen in connection with bronchiectasis, lack of pneumatization of the mastoid is an almost constant feature of the Kartagener triad. In any case, arrested development of the frontal sinus as demonstrated roentgenographically should lead to suspicion of bronchiectasis.—*Harold Fulton, M.D.*

Leiber, Bernfried, and Pabst, Rudolf. Die Röntgendurchleuchtung der Nasennebenhöhlen als Teil der Allgemeinuntersuchung. (Roentgenoscopy of the nasal accessory sinuses as part of the general examination.) *Die Medizinische*, Jan. 24, 1953, 121–124.

The author believes that the great number of abnormalities which will be discovered by fluoroscopic examination of the nasal accessory sinuses justifies such a procedure to be done routinely as much as possible.

The factors are 60 to 70 kv. and 3 to 4 ma. The head is placed in the same position as used in the standard roentgenographic procedures for visualization of the various sinuses. The examination can be done immediately after fluoroscopy of the chest with the patient upright and may furnish as much if not more information than will the roentgenographic technique. The findings must be correlated with the clinical data. The abnormal signs indicative of pathological changes are similar to those seen on the films. Occasionally, roentgenograms are taken to confirm the fluoroscopic findings.

The method is simple, inexpensive, and raises no objection from the patient.—*Samuel Richman, M.D.*

Neck and Chest

Kay, Earle B. The inferior esophageal constrictor in relation to lower esophageal disease. *J. Thoracic Surg.*, Jan., 1953, *25*, 1–15.

The author gives his observations and opinions on the relationship of the anatomy and physiology of the esophagus to achalasia or mega-esophagus, pulsion diverticula and idiopathic strictures of the distal esophagus. The inner esophageal muscular layer of circular and elliptical fibers is described and emphasis is placed on a thickening of this layer 1 to 3 cm. above the diaphragmatic hiatus which is referred to as the inferior esophageal sphincter. Muscular control in deglutition is mostly controlled by the parasympathetic and sympathetic nervous systems. A preponderance of sympathetic control as with dysfunction or absence of the ganglion cells of Auerbach's plexus or vagus nerve may produce a contraction and hypertrophy of the inferior esophageal sphincter to effect a functional obstruction.

The role of the inferior esophageal constrictor in its hypertrophied state can often be demonstrated in achalasia by direct vagal stimulation or amyl nitrite action with subsequent relaxation of the obstructing inferior sphincter and contraction of the esophageal musculature elsewhere.

Cases of pulsion diverticula of the esophagus are cited in which a hypertrophied band of circular muscle, apparently acting as an obstructing barrier, has been found just distal to the diverticulum. Also a high percentage of cardiospasm is reported in patients with pulsion diverticula and it is suggested that functional stenosis from a hypertrophied inferior esophageal constrictor causes increased intra-esophageal pressure and herniation of the mucous membrane through weak areas of the inner muscular layer to form diverticula.

A similar theory may help explain strictures of the distal esophagus. The situation in which the inferior esophageal constrictor is hypotonic and the diaphragmatico-esophageal ligament is relaxed will permit herniation of the stomach into the posterior mediastinum and regurgitation of the gastric juice producing peptic esophagitis and subsequent stricture formation and esophageal shortening. A faulty closing of the inferior esophageal constrictor without a hiatus hernia allows regurgitation and peptic esophagitis. The latter patients usually give a long history of eructation and heartburn suggestive of esophagitis prior to the development of stricture. It is proposed that in older people who have no pre-existing esophageal or gastric complaints, the organic stricture may be secondary to esophagitis produced by stasis resulting from slight functional obstruction by a hypertrophied inferior esophageal sphincter.—*Paul C. Olfelt, M.D.*

ANSELL, G. Diagnosis of intrathoracic goitre. *J. Faculty of Radiologists*, Jan., 1953, *4*, 197–206.

The author makes a distinction between "intrathoracic goiter" when some portion of the thyroid remains permanently within the thoracic cavity and "deep goiter" when the lower poles of the thyroid extend into the thoracic inlet only at rest but rise completely out of the thorax during swallowing.

Roentgenologically, the intrathoracic goiter manifests itself as a shadow in the upper mediastinum. The differential diagnosis includes numerous lesions which are the following: aortic and other aneurysms; enlargement of the mediastinal lymph nodes due to lymphoma, bronchial carcinoma or tuberculosis; thymoma; esophageal diverticulum; mediastinal abscess; dermoid cyst and other cysts; certain benign tumors, as for example, fibroma of the esophagus; primary lung tumors; and neurogenic tumors. By taking into consideration the available clinical and laboratory data and by making use of various roentgenologic procedures, it is possible to establish the correct diagnosis in most instances. There will be, however, a few cases in which diagnosis cannot be made. In such instances tracer study with radioactive iodine (I^{131}) which is known to be taken up by functioning thyroid tissue is of definite value.

In the present article the author reports the results of his investigation with I^{131} in a series of 15 cases of suspected intrathoracic goiter examined between September, 1947, and May, 1951. The method used has been described in detail elsewhere (Ansell, G., and Rotblat, J. *Brit. J. Radiol.*, 1948, *21*, 552). Briefly, a tracer dose of I^{131} is given orally and, twenty-four hours later, the neck and upper chest are scanned for radioactivity with a specially collimated Geiger-Müller counter. Each position of the counter is marked in numerical order by placing a circle of adhesive plaster on the skin indicating the number of counts per unit time interval. A lead marker of 1 inch square is also fixed to the chest wall. After completion of the scanning, the patient's chest including the lower neck is photographed and a roentgenogram of the chest with the lead marker in position is also made. The radioactive contour is then drawn and correlated with the upper mediastinal shadow shown on the roentgenogram.

The following final diagnosis was reached in the 15 patients: intrathoracic goiter, 8 cases; deep goiter, 5 cases; bronchogenic cyst of the mediastinum, 1 case; and lymphoma of the mediastinal lymph nodes, 1 case. The case histories of several of the patients are reported in greater detail in order to illustrate the various features affecting diagnosis.

The conclusion is reached that tracer study with I^{131} is of definite value in differentiating intrathoracic goiters from other upper mediastinal lesions, although intrathoracic goiters with extensive necrotic, cystic or malignant change usually do not concentrate radioactive iodine and thus may escape detection.—*T. Leucutia, M.D.*

MACAULEY, C. A case of hyperparathyroidism. *Irish J. M. Sc.*, March, 1953, *6*, 124–125 and 130.

This is a case report of a fifty-two year old woman with hyperparathyroidism with an elevated serum calcium and a lowered serum phosphorus who was operated on. The patient presented cystic areas in the tibia which recalcified after operation.

There is a short discussion of hyperparathyroidism. The statement is made that the most marked changes are seen in the long bones, the pelvis, skull, jaws, and ribs but no mention is made of the changes in the phalanges of the hands or in the lamina dura. —*J. M. Dell, Jr., M.D.*

DERRYBERRY, O. MERTON. Mass screening techniques for chest diseases; industrial medical aspects. *J.A.M.A.*, Jan. 10, 1953, *151*, 112–114.

Mass surveys of the chest are not intended to establish a final diagnosis but to focus attention on abnormal conditions in order that further study can reveal what the abnormality is and what should be done about it. The usefulness of the survey in the discovery of other abnormalities than tuberculosis has become increasingly recognized.

Mass screening for chest disease in an industrial medical service has been an effective tool for preventive medicine. Detection of many cases of communicable and noncommunicable disease has resulted in early treatment with benefit to the employee, his associates, and the employer.

The potential benefits of mass screening are greatest in the presence of a full-time health service in the industrial organization which is directed by an adequately trained physician. With good follow-up, the survey results can become part of the employee's medical record. As a rule, a high percentage of employee participation can be obtained; suspicious, positive, or independent findings can be followed conveniently, effectively, and economically for both employee and employer; there is a greater assurance that treatment will be received, since both medical guidance and the assistance of employee welfare associations are available; and better opportunities for rehabilitation can be worked out, including appropriate job placement on return to duty or disability retirement, if the latter is indicated.—*Norman Heilbrun, M.D.*

CHRISTIE, ARTHUR C. Mass screening techniques for chest diseases. *J.A.M.A.*, Jan. 10, 1953, *151*, 114–117.

The author discusses the present status of the tuberculosis control program in the United States as

related to the mass screening method. The tuberculosis Control Division of the United States Public Health Service, established in 1944, rapidly developed an organization for cooperation with municipal, county, and state health departments, on the one hand, and with the National Tuberculosis Association and its local units, on the other. Through its leadership, mass surveys in many localities throughout the nation have followed as rapidly as available apparatus and trained personnel would permit. One of the admirable results of the many surveys has been the demonstration of complete cooperation among all the agencies, whether public or private, official or nonofficial.

The mass screening process was extended to the civilian population (15 years of age or over) in 1946. About 50 million examinations were made from 1946 to 1950 inclusive. The surveys covered the United States from coast to coast and included all types of communities on all economic levels.

Much important knowledge was gained. The method is of little value unless there is careful follow-up of the positive cases. These follow-up studies can have far-reaching statistical value, but it is necessary to have a uniform method of counting and tabulation prepared in advance. The doubtful as well as the positive cases must be followed.

The initial examination of every positive case should be made at a central diagnostic clinic; the findings carefully explained to the patient; the need for follow-up emphasized; and the patient referred to a private physician or clinic with all available data. The health department is responsible that the case receives the necessary supervision.

A certain number of cardiac and other nontuberculous conditions will be found. The data referable to these cases must also be preserved and available for follow-up study.

No mass screening effort is complete until every person examined has received a final diagnosis and has been assigned to a definite category for follow-up and treatment.

One of the inherent limitations of the mass survey is that it will only include a certain percentage of the population. In Washington, D. C., only 41 per cent of the estimated population was examined, representing 39 per cent of the white and 45 per cent of the nonwhite population. Of the cases discovered, 65 per cent were known to the health department and 35 per cent unknown. The large percentage of unknown cases indicates the need for continuing the efforts to screen out the cases of tuberculosis. Screening efforts may be concentrated in areas with a high prevailing rate. Another significant disclosure was that 25 per cent of the tuberculosis patients were fifty-five years of age or older, whereas this age group comprised only 10 per cent of the population examined. Case findings must be directed with increasing intensity toward the older age group.

As experience is gained, the planning for the future can be continued. Since the death rate for tuberculosis has been decreasing, there is a great need for accelerating the program of casefinding.—*Norman Heilbrun, M.D.*

Peck, Mordant E., Neerken, Adrian J., and Salzman, Emmanuel. Clinical experience with the water-soluble bronchography compounds. *J. Thoracic Surg.*, March, 1953, *25*, 234–245.

The chief advantage of the water-soluble bronchographic compounds is their disappearance from view shortly after the examination. These media do not produce as great a density as iodized oils and, therefore, may not obscure small parenchymal lesions as much. The lesser degree of contrast of the water-soluble media is usually a disadvantage. Another disadvantage is that the examination must be made within a few minutes since these agents are absorbed with great rapidity. The water-soluble media produce a marked degree of bronchospasm and hence anesthesia must be more thorough. It is suggested that these agents may produce a localized allergic response. The latent effects of the water-soluble compounds upon the pulmonary tissue are not clearly understood. A pulmonary fibrotic reaction surrounding small retained foci of carboxymethyl cellulose and glycomethyl cellulose, the bases of some water-soluble media, has been reported.

In a review of 56 consecutive bronchograms performed with methocel-diodrast, 66.7 per cent were judged satisfactory, which compared to 15.9 per cent unsatisfactory results in a series of 528 bronchograms made with lipiodol.

Two deaths are reported which followed bronchographies in which methocel-diodrast and methocel-urokon were used. The authors believe the high molecular carbohydrate base of these media precipitated fatal anaphylactic reactions.—*Paul C. Olfelt, M.D.*

Vieten, H. Probleme der bronchographischen Tumordiagnostik. (Problems of the bronchographic diagnosis of tumors.) *Chirurg*, March, 1953, *24*, 101–105.

The modern method of bronchography is characterized by the following: (1) the use of water-soluble contrast media in place of the formerly used iodized oils. The author employs almost exclusively per-abrodil bronchography; (2) direct instillation of the bronchial tree with visualization of a single lobe or a segment; (3) necessity of endobronchial anesthesia due to irritation from the water-soluble contrast medium.

The goals of the bronchographic examination in pulmonary tumors are the early diagnosis of bronchial carcinoma, the differential diagnosis of bronchial stenosis and the determination of operability.

A peripheral carcinoma of the bronchus causes

early stenosis of the lumen, while this is a late sign in a carcinoma of more central location. An effective method, therefore, should visualize early mucosal alterations. The author in a few cases has demonstrated early bronchographic changes which had not been seen at bronchoscopy. The term "early diagnosis" should be reserved for cases which are still operable. Radical operation is possible in carcinomas which are at least 3 cm. distant from the bifurcation. The so-called "inhalation bronchography" is also discussed but this method is still in a purely experimental stage.

The bronchographic differential diagnosis of bronchial stenosis is not very satisfactory, since the shape and length of the stenosis are not of distinct diagnostic significance. A cone-shaped narrowing, however, is always suggestive of carcinoma. Of 559 cases of bronchial stenosis, 500 represented instances of carcinoma. In these surgery is always indicated unless a malignant neoplasm is definitely ruled out.

For the determination of operability, the bronchographic localization is of the greatest value. If a tumor has extended into a main bronchus, it is considered probably to be inoperable since mediastinal changes (metastases to lymph nodes or fixation) have already taken place.—*E. G. Wissing, M.D.*

Blount, S. Gilbert, Jr., Komesu, Seiichi, and McCord, Malcolm C. Asymptomatic isolated valvular pulmonary stenosis; diagnosis by clinical methods. *New England J. Med.*, Jan. 1, 1953, *248*, 5–11.

Until recently, isolated pulmonary stenosis has been considered to be a rare congenital cardiovascular anomaly. This article stresses the fact that the condition is now known to be more common than was formerly thought and that it is an asymptomatic malignant, progressive entity.

Six cases of this anomaly are discussed with evaluation of the clinical, roentgen, and laboratory aspects. The clinical findings are stressed and diagnosis on this basis is considered. In addition to the physical findings the fluoroscopic examination is felt to be of great importance. Poststenotic dilatation of the pulmonary artery is always present and there is a disproportion between the amplitude of pulsation of the main pulmonary artery segment and the right and left pulmonary arteries themselves. Vascularity of the lung fields may be diminished along the periphery. The cardiac size may be normal but there also may be hypertrophy of the right ventricle. The right auricle may also be enlarged. Right auricular enlargement with a normal sized heart in a patient without symptoms is considered to suggest the possibility of isolated pulmonary stenosis.

The place of cardiac catheterization is also discussed in diagnosis and management of cases of pure pulmonary stenosis.—*William A. Klauber, M.D.*

Oyamada, A., Gasul, B. M., and Holinger, P. H. Agenesis of the lung; report of a case, with a review of all previously reported cases. *A.M.A. Am. J. Dis. Child.*, Feb., 1953, *85*, 182–201.

The authors report a case of true agenesis of the lung which showed no trace of lung, bronchus or vascular supply on the right side. A clinical diagnosis of agenesis of the lung can usually be suspected on the basis of the physicalfindings, the roentgenographic and fluoroscopic findings of displacement of the mediastinum and heart toward the affected side, especially if associated anomalies of the spine and ribs and other anomalies are present.

A complete review of previously reported cases is presented in the article, consisting of aplasia of one lung, congenital aplasia of one or both lungs, and a listing of doubtful cases of lung aplasia and congenital hypoplasia.—*Ralph S. Bromer, M.D.*

Morle, K. D. Forgan, and Robertson, Philip W. Segmental aspiration pneumonia and bronchiectasis. *Brit. M. J.*, Jan. 17, 1953, *1*, 130–133.

Primary atypical virus pneumonia of a segmental nature is due to aspiration and can result in irreversible bronchial changes. These can progress to a bronchiectasis.

The bronchogram is considered abnormal if one or more of the following features are present: (a) dilatation of the bronchi, (b) crowding; approximation and crowding together of the bronchial shadows, (c) lack of filling of the peripheral bronchi, (d) distortion and angulation of the peripheral bronchi and irregularity of the bronchial walls.

Sixty to 70 per cent of all cases of segmental aspiration pneumonia show bronchial abnormality with lack of filling of the peripheral bronchi. Signs and symptoms as the result of bronchial changes persist after the pneumonia has supposedly cleared. The bronchial plugging may occur from failure to eliminate the excessive bronchial secretion. This type probably forms most of the bronchopneumonic illnesses of childhood. History will usually show that there have been recurrent inflammatory episodes in that segment with the bronchiectatic changes.

When a segmental lesion with bronchial changes is found it should be observed for a period of at least six months. Bronchography is employed as a guide to the progress. Some cases do show a reversion in repeat bronchograms. It is advisable to resect the diseased portion of the lung to prevent spread to other portions of the healthy lung. In the medical management one must be guided as to whether the predominating factor is infection or mechanical. Many patients recover rapidly without specific therapy. The antibiotics should be restricted only to those cases where the infective element predominates. Treatment should aim to reverse the sequence of events which led to the development of the seg-

mental pulmonary lesion. The material which has been aspirated should be removed by suction, and proper postural drainage instituted to prevent stagnation within the bronchi. Expectorant mixtures have little or no effect in clearing the bronchi.—*Joseph Levitin, M.D.*

Gellis, Sydney S., Reinhold, John L. D., and Green, Sidney. Use of aspiration lung puncture in diagnosis of idiopathic pulmonary hemosiderosis. *A.M.A. Am. J. Dis. Child.*, March, 1953, *85*, 303–307.

Idiopathic pulmonary hemosiderosis is a rare disease affecting children and young persons between the ages of a few months and sixteen years. Only 1 case has been recorded of this disease occurring in an adult. In the case reported in this article the clinical diagnosis was confirmed by aspiration lung puncture which yielded macrophages loaded with hemosiderin granules.

The clinical picture consists of recurrent attacks of fatigue, cyanosis, fever, pallor and increasing dyspnea which occur suddenly and are associated with a marked degree of iron-deficiency anemia with features suggesting hemolysis, although a true intravascular hemolysis is not observed. Transient enlargement of the spleen and liver occurs in some cases and slight jaundice may follow the acute attacks. In long-standing cases, evidence of right ventricular hypertrophy is usually present and clubbing of the fingers may be noted.

The changes in the lungs seen on the roentgenogram may be quite characteristic. The commonest feature consists of mottled shadows in the hilar regions and diffuse speckling throughout the peripheral lung fields.—*Ralph S. Bromer, M.D.*

Jones, W. A. The solitary pulmonary focus—carcinomatous or otherwise, with particular reference to histoplasmosis. *J. Canad. A. Radiologists*, March, 1953, *4*, 15–19.

The author discusses multiple disseminated pulmonary calcifications in addition to solitary pulmonary foci, or "coin lesions," each of which he feels is more frequently the result of histoplasmosis than is realized.

In the many cases of disseminated calcified scars without history of a serious illness, in which histoplasmin skin tests are positive and tuberculin tests negative, histoplasmosis has become accepted as the probable cause rather than miliary tuberculosis.

In a like manner the author feels that in evaluating a solitary pulmonary focus histoplasmosis should be considered, along with tuberculoma, carcinoma, and hamartoma. Three patients are reported, each having no respiratory symptoms but whose chest roentgenograms showed a solitary parenchymal focus, with a calcified center and a halo. In 1 case the presence of histoplasmosis was established by excision, in the others by a strongly positive histoplasmin skin test associated with a negative, or weakly positive, tuberculin test. The calcified nidus surrounded by a radiolucent halo within the lesion is held to be of diagnostic importance. The demonstration of this finding makes tuberculoma less likely, but does not exclude it. Carcinoma is excluded by the presence of calcification, and hamartoma is ruled out because the calcification is solid rather than scattered.

In all cases of solitary pulmonary lesions, especially with the characteristics described above, a histoplasmin skin test is recommended as a simple test to precede more involved procedures.—*John F. Weigen, M.D.*

Stevenson, F. Harwood. Infected arteriovenous fistula in the lung. *Lancet*, March 28, 1953, *1*, 626.

A case history is presented of a patient with a pulmonary arteriovenous fistula, associated with hereditary telangiectasia, in which an infectious endarteritis is thought to have occurred. Septicemia due to *Staph. pyogenes* was cured with penicillin and aureomycin and the patient is well two years later.

Only 1 similar case was found in the literature. In neither case, however, was unequivocable proof obtained that the arteriovenous fistula was the site of the primary infection.—*John F. Weigen, M.D.*

Gilbert, Joseph W., Myers, Richard T., and Bradshaw, H. H. Pulmonary cysts; report of twenty-one cases. *J.A.M.A.*, March 28, 1953, *151*, 1075–1078.

Twenty-one cases collected over a period of eight years are discussed. Of these, 7 are described in detail with relevant clinical, operative, and roentgenographic findings. Less than 50 per cent were correctly diagnosed in the clinic or elsewhere.

Classification has been confused in the past, but the authors suggest one based on a primary division into congenital and acquired. The pathologic interpretation was made difficult by the associated inflammatory and compressive changes, and in some cases no definite classification could be arrived at. Of the 21 cases, in 15 the cysts were found to be bronchogenic, in 3 lined with alveolar epithelium and in 3 indeterminate. The bronchogenic type was encountered in the younger age group, and 2 patients were thirteen and fourteen days old respectively.

The most common preoperative complication was infection and in the younger age group tension phenomena. In 3 cases of the bronchogenic type, other pulmonary anomalies were found at operation.—*William E. Craddock, M.D.*

Gross, Stanley, and Wood, Colin. Hibernoma. *Cancer*, Jan., 1953, *6*, 159–163.

A hibernoma is a benign fatty tumor. It is similar

to the "brown fat" seen in the glands of hibernating mammals. It is also found in fat deposits of non-hibernating mammals as the white rat and mouse. Occasionally it is found in man. Microscopically, the fat differs from the common yellow colored fat. It has a distinct lobular pattern with a rich vascular supply. The cells are multilocular. The fat vacuoles are small. The cells have a greater content of unsaponifiable fat and cholesterol.

Two cases are described. In one the hibernoma was intrathoracic, involving the left apex. It was mistakenly diagnosed as a neurofibroma. In the second case it was located in the left axilla and was diagnosed as a fibrolipoma. In both cases the tumors were successfully removed.—*Joseph Levitin, M.D.*

Wegelius, Carl, and Lind, John. The role of the exposure rate in angiocardiography. *Acta radiol.*, March, 1953, *39*, 178–191.

The authors discuss the importance of the exposure rate in angiocardiography. Two methods may be recognized: the "anatomic" and the "dynamic."

The "anatomic" or standard technique consists of a series of films showing each of the separate chambers in at least one of the films. No consideration is given to the phase in the heart cycle in which the exposure is made.

The "dynamic" method becomes possible when fast serial exposures are made so that the extremes of one heart cycle including material diastole and systole as well as a sufficient number of intermediate phases are roentgenographed in sequence. In this way the dynamics of the heart may be studied.

The opacity of the heart is related to the circulation rate and the time should be expressed in terms of heart cycles rather than in seconds. The time of injection should not be longer than a duration of from 3 to 4 heart cycles, the equivalent of the pulmonary circulation time. The total time for the adequate filling of the left side of the heart and great vessels is limited to from 8 to 12 heart cycles from the time of arrival of the contrast medium in the right auricle. This corresponds to total times of from six to nine seconds for cardiac contrast visualization at a heart rate of 90 per minute, from four to six seconds at a rate of 120 per minute and only three seconds at a rate of 180 per minute.

In the infant it will require at least three exposures per heart cycle to catch the auricle and ventricle both in systole and diastole. With a frequency of three heart cycles per second there must be at least nine exposures per second. At this speed one film is obtained of each auricular systole and ventricular diastole and two films of each auricular diastole and ventricular systole. Since a safety margin of from one to three additional films per second gives a greater chance of assessing the dynamics of the complete heart cycle it becomes necessary to have a minimum exposure rate of from ten to twelve films per second. With heart rates of 90 per minute, from five to six films per second will be sufficient.

The length of exposure time is of considerable importance. The longest exposure time permissible will be only 0.02 second with a heart rate of 180 per minute. With slower heart rates the exposure time may be from 0.03 to 0.04 second.

By combining the films with a synchronous electrocardiogram with automatic exposure marks taken off one of the standard leads, direct legible correlation between the intervals of the exposures and the phase of the heart cycle may be obtained. In this way the separate films may be timed in relation to the heart cycle.—*J. N. Ané, M.D.*

Gadermann, E., and Schrader, E.-A. Bemerkungen zur Methodik und klinischen Bedeutung der Aortographie. (Technique and clinical significance of aortography.) *München. med. Wchnschr.*, March 20, 1953, *95*, 348–350.

Based on their experience with over 100 aortographies performed on ambulatory patients, the authors find that hospitalization of patients for the purpose of performing aortography is unnecessary.

Two small caliber cannulas (1.2 mm. outer diameter and 14–16 cm. in length) rather than a single larger cannula are used, and 40 cc. of 80 per cent perabrodil is injected. Either the subdiaphragmatic or the lumbar aorta is chosen by a left approach, depending on the clinical indications. No medication or local anesthesia is necessary.

By using small cannulas injury to the vessel wall and the danger of accidental puncture and injection of a small artery (mesenteric or renal artery) are minimized. The patient is able to leave the hospital immediately after removal of the cannula.

One case is discussed to show that the patient's progress can be followed by repeated (ambulatory) aortographies without ill effects.—*Frederick M. Reis. M.D.*

Fowler, Noble O., Jr. Cardiac catheterization in the diagnosis of adult heart disease. *Ann. Int. Med.*, March, 1953, *38*, 478–511.

Fifteen cases of cardiac catheterization in adults are described in detail together with their relevant case reports and roentgen findings. The cases were selected from a total of 128 adult catheterizations and cover a wide range of congenital and acquired heart disease, and also pulmonary diseases.

The technique of catheterization by the method of Cournand and Ranges is fully described, also the contraindications to the procedure and the complications. Normal ranges of pressure and oxygen content of the blood in the various chambers and vessels are listed and the significance of pathological variations discussed. Calculations for cardiac output,

systemic and pulmonary flow, valve area, etc., are also given.—*William E. Craddock, M.D.*

Friedman, Robert L. Loculated azygos fissure effusion in cardiac failure. *Ann. Int. Med.*, March, 1953, *38*, 582–585.

Interlobar effusions are not uncommon in cardiac failure. They are usually located in the right lesser fissure. Since the average incidence of an azygos lobe is below 1 per cent, the infrequency of loculation of effusion in the azygos fissure is more readily understandable.

The author reports what he believes to be the third case recorded. In a sixty year old male with chronic cardiac insufficiency who, on the first admission, was noted to have right pleural effusion and an azygos lobe, a decortication of the right lung lung was attempted.

On the second admission the azygos fissure was not seen but there was a fusiform homogeneous density in this region, suggesting loculated azygos fissure effusion. After digitalization and mercuhydrin therapy, the density disappeared and the azygos fissure was again seen.

A review of the pertinent literature is presented.—*Wallace M. Roy, M.D.*

Letteer, C. Ralph. Endocardial fibroelastosis. *Ann. Int. Med.*, March, 1953, *38*, 573–582.

This is a report on 2 cases of this infrequently recognized but not uncommon disease.

Both cases were those of infants, aged six and fourteen months. The presenting symptoms were respiratory distress, cough, and in 1 case cyanosis. The striking roentgen finding in each case was a marked enlargement of the heart. The outcome was rapidly fatal. Postmortem examinations revealed marked cardiac hypertrophy and dilatation. The endocardium of the left ventricle was greatly thickened and presented a smooth, glistening, opaque, grayish-white appearance. On microscopic examination the endocardial thickening was found to be composed of abundant elastic and collagen fibers.

The author has made an extensive review of the literature and notes the confusion in terminology and the failure to recognize the importance of endocardial thickening.

Clinical Manifestation: The cardinal and indispensable feature is marked cardiac enlargement.

Etiology: Maldevelopment of the endocardium itself is the most tenable explanation at the present time.

The author believes that endocardial fibroelastosis is a distinct clinical and pathologic entity, and that it is the common denominator in cases which have been described under various terminology as congenital idiopathic hypertrophy, endocarcial fibrosis, endocardial sclerosis and fetal endocarditis.—*Wallace M. Roy, M.D.*

Ramos, Miguel, and Mount, Lester A. Carotid cavernous fistula with signs on contralateral side; case report. *J. Neurosurg.*, March, 1953, *10*, 178–182.

The authors report a case of carotid cavernous fistula with signs on the contralateral side.

Complete arteriographic studies were carried out and these demonstrated evidence of an internal carotid-cavernous sinus fistula which drained through the anterior part of the circular sinus to the left cavernous sinus and left superior ophthalmic vein. The bruit over the left eye was not obliterated by bilateral carotid compression because of a large right posterior communicating artery which carried blood to the fistula from the basilar artery.

They state that this case emphasizes the necessity of complete arteriographic studies in order to obtain an accurate diagnosis of the side of the lesion and of the collateral circulation, both of major importance for proper surgical therapy.

The surgical treatment of arteriovenous fistula between the internal carotid artery and the cavernous sinus, as described by Dandy, proved to be satisfactory in this particular case.—*C. Peter Truog, M.D.*

Santos, Carlos. Surgical removal of foreign bodies with the aid of stereoscopic fluoroscopy; report of a case involving needle in pericardial cavity. *Postgrad. Med.*, Feb., 1953, *13*, 123–132.

The author has performed surgical removal of foreign bodies in almost 3,000 cases by using plain fluoroscopy for thirty years and stereoscopic fluoroscopy for about ten years as his guide. In this article he reports in considerable detail a very unusual case in which a portion of a needle was removed from the pericardium transthoracically with the aid of stereoscopic fluoroscopy, thus proving again the great practical value of this method (described by the author in: Pillmore, G. U. Clinical Radiology, F. A. Davis Company, Philadelphia, 1947, Vol. 2, pp. 671–676).

The case is that of a four month old male infant who was brought from the Azores to the Hospital de Sâo José of Lisbon on March 26, 1951, five weeks after a needle penetrated his lower chest on the left side. Roentgenologic examination showed the needle to be located in the pericardial cavity between the heart and the diaphragm, its outer end being embedded in the pericardial membrane just behind the apex of the heart.

In view of the fact that the needle followed the movement of both the diaphragm and the pulsating heart, a special stylet was devised for fixing the pericardium while grasping and extracting the foreign body with the forceps. The author's forceps, his stylet used for cutting the tissues about the needle, and the stylet used for fixing the pericardium are de-

scribed at length and illustrated with photographs.

The operation was performed on March 30 under rectal pentothal sodium anesthesia followed by local injection of procaine hydrochloride with epinephrine. A preliminary pneumothorax was done to displace the lung from the path of the instruments used for extraction. A satisfactory three dimensional visibility was obtained with the aid of the stereoscopic fluoroscope through a field only 4 by 4 cm. square, so as to protect the surgeon's hands as much as possible. The needle was removed without difficulty, although the operation, owing to the complicated maneuvers involved, required more time than is usual for such procedures.

After developing a temporary subcutaneous emphysema the cause of which was not clear, the patient has recovered fully and was found to be in excellent condition six months later.—*T. Leucutia, M.D.*

Abdomen

Nolan, John J., and Lee, J. Gordon. Duplications of the alimentary tract in adults; with a report of three cases. *Ann. Surg.*, March, 1953, *137*, 342–348.

The authors classify duplications of the alimentary tract, as (1) tubular, and (2) spherical—which they consider a more accurate term than enterogenous cyst, enterocystoma, or inclusion cyst, although these terms have been more commonly used in the past. In order to qualify as a duplication, there must be a common muscularis between the duplication and parent viscus, and it must be impossible to establish any plane of cleavage. They point out that the condition is fairly frequent in children, but they were able to find only 16 cases in adults in American and British literature. Clinical manifestations are varied, and include volvulus, intussusception, massive hematemesis and inferior vena cava compression. The lesion may accidentally be discovered on a routine chest roentgenogram. Where there is an abundant blood supply, such as in the stomach, the duplication may be removed by resection, but in other cases where the duplication is connected with a tubular structure, such as the esophagus or small intestine, resection of a part of the alimentary tract may be necessary. They state that alimentary tract duplications have been found from the oral cavity to the rectum; they consider that the congenital type of gastric diverticula are probably closely related to gastric duplications, but the pulsion and traction diverticula of the stomach and the common type of diverticulosis of the large and small intestine are not related. They present 3 cases, encountered on the surgical service of the Veterans Administration Hospital, Washington, D. C., within a period of six months.

Case 1. Chest roentgenogram of a fifty year old colored male showed an oval mass posterior to the heart, primarily diagnosed as a mediastinal tumor. The thoracic surgeon made a preoperative diagnosis of duplication of the esophagus. At operation a smooth oval thin-walled cystic structure, approximately 7 cm. in greatest diameter, attached to the left lateral aspect of the esophagus by 1.4 cm. area of common muscularis was found. It was removed without entering the esophageal lumen. The pathological diagnosis was duplication of the esophagus.

Case 2. A thirty-five year old colored male had a history of cramping upper abdominal pain, melena and hematemesis. Roentgen examination showed a large filling defect in the fundus of the stomach, and evidence of a penetrating duodenal ulcer. Because of persistent bleeding the patient was operated upon. The duplication was not recognized and was thought to be an intramural hematoma, since foul smelling clotted blood was evacuated when the region of the filling defect was opened. A biopsy was taken from the gastric wall, and it was found that all gastric layers were present. The duplication was marsupialized in the line of the incision. A gastrotomy in the antrum failed to reveal a duodenal ulcer, but it was possible to see a small circular stoma between the duplication and the lumen of the stomach.

The patient was re-examined postoperatively and barium was seen to enter the accessory stomach at a point near the esophagogastric junction, and to drain out through the marsupialized opening. A second operation was performed and the duplication was removed; it was necessary to remove a portion of the gastric wall, but there was no difficulty in securing closure. No evidence of duodenal ulcer was seen at operation, and a follow-up gastrointestinal study on the 14th postoperative day showed a normal duodenal cap.

Case 3. This case was that of a thirty-one year old colored male, admitted with a complaint of abdominal pain associated with vomiting. A similar attack six years previously had subsided spontaneously, Because of tenderness in the right lower quadrant both through the abdominal wall and rectally, and the absence of a palpable mass, a preoperative diagnosis of acute appendicitis was made, and the patient was operated upon. An ileoileal intussusception 63 cm. in length, 78 cm. from the ileocecal valve was found. The intestine proximal to the intussusception was not dilated. Since it was impossible to reduce the intussusception the involved intestine was resected and continuity was restored by an end-to-end closed anastomosis. The intussusception was initated by a 2.0 cm. diameter thick-walled spherical tumor having a small lumen, shown on pathological examination to be a duplication of the ileum, without communication between the lumen of the ileum and the lumen of the cyst.

The authors emphasize that awareness of the possibility of the condition is the most important prerequisite for accurate diagnosis.—*Angus K. Wilson, M.D.*

Bogsch, Albert. Permanent deposition of iodine contrast medium in the wall of the stomach. *Acta radiol.*, March, 1953, *39*, 219–224.

The author describes a case in which the lower two-thirds of the stomach and the mucosal pattern were excellently outlined on a plain roentgenogram which was made to ascertain the position of a duodenal tube. An autopsy examination was performed some time later. Examination of the tissue by chemical means proved that the opaque material in the wall was iodine. Some cholecystographic examinations had been performed three years before. This was the only history of iodine ingestion.

Based upon the pathological findings, the following explanation for the deposition of the iodine is suggested. There were cicatricial subhepatic adhesions secondary to repeated gallbladder inflammation. The cystic and common ducts were markedly distended by stones. They were also tightly constricted by the surrounding connective tissue. Lymph ducts had grown into this tissue and they ran to the antral and pyloric portions of the stomach. Due to the obstruction of the common duct, the absorbed gallbladder contrast medium could not pass down the duct, so it filled the newly formed lymph vessels leading to the stomach wall. Due to inflammatory changes, these lymph vessels became occluded and the contrast medium remained deposited for a protracted period of time and was disclosed at the roentgen examination three years later.—*Norman Heilbrun, M.D.*

Matzinger, K. E. Gastric diverticula. *J. Canad. A. Radiologists*, March, 1953, *4*, 23–25.

The article is a review of gastric diverticula and case histories of 2 patients with true diverticula.

Gastric diverticula are rare, with an incidence of 0.1 per cent or less in reported series of barium studies. True diverticula, which are outpouchings of all layers of the gastric wall, are probably congenital in origin and occasionally contain aberrant pancreatic tissue. Diverticula due to other pathology, classified as false diverticula, occur secondary to a variety of causes, including perigastric adhesions, increased intragastric pressure, foreign bodies, gastric ulcers with circumscribed perforation, scar formation following ulceration with retraction, and ulcerating tumors, such as neurofibromas.

Roentgenologically a true diverticulum appears as a sac-like outpouching of the gastric mucosa, with intact mucosal rugae at the neck of the sac. Retention of barium for twenty-four hours or longer may occur and a layer of fluid and air can sometimes be seen above the barium in the diverticulum.—*John F. Weigen, M.D.*

Martin, F. R. R., and Carr, R. J. Crohn's disease involving the stomach; report on two cases. *Brit. M. J.*, March 28, 1953, *1*, 700–702.

Regional ileitis, ileojejunitis, and ileocolitis in continuous areas of mucosal involvement or proximal and distal to skip areas have been recognized for years. Crohn in 1949 reported instances of involvement of the second and third portions of the duodenum.

The authors report 2 patients who had Crohn's disease involving the stomach. These 2 young female adults had symptoms and signs of regional enteritis. Histopathological evidence obtained in 1 case revealed lymphocytic stromal infiltration with plasma cells and endothelial cells as well. No caseation or bacilli were found.

The authors suggest that when persistent vomiting and anorexia occur in Crohn's disease without intestinal obstruction, the possibility of gastroduodenitis should always be considered.

The roentgenological changes may simulate those of gastric carcinoma of the diffusely infiltrating type. The findings in the 2 cases included absent gastric peristalsis, abnormal mucosal pattern of the pylorus and duodenum, gastric dilatation, excess of fasting juice and normal emptying rate. These findings later reverted to normal with general improvement of the patients.—*John W. Turner, M.D.*

Vaughn, Arkell M., and Rooney, James A. Foreign body in the stomach wall simulating a neoplasm. *J.A.M.A.*, March 21, 1953, *151*, 990–991.

Surgeons should consider the possibility that the patient may have ingested a foreign body, if he has vague gastrointestinal symptoms that persist unchanged.

Symptoms, diagnosis and treatment of ingested foreign bodies are discussed and a case is reported in a forty-one year old male of Syrian extraction. The foreign body simulated a gastric neoplasm at the time of surgery. The patient had no knowledge of ingesting the foreign body, and preoperative diagnosis was inconclusive. Adequate medical management did not control the symptoms and surgery was performed for the duodenal ulcer found at roentgen examination. A hard indurated mass 1.5 cm. in diameter was found on the greater curvature. A subtotal gastric resection was performed supplemented by bilateral abdominal vagotomy. On opening the mass a small pin or wire was found penetrating the stomach wall in an oblique fashion. The patient remained symptom free.

It is emphasized that in differential diagnosis of all gastric lesions, one must consider the possibility of a foreign body lodged in the stomach.—*Robert D. Moreton, M.D.*

LAMPE, CARL ERIK. A case of duodenohepatic reflux demonstrated by routine barium meal. *Acta radiol.*, Feb., 1953, *39*, 169–173.

The author reports a case of duodenohepatic reflux of contrast medium during barium meal study due to patency of the sphincter of Oddi. He cites the following three causes for reflux of contrast medium into the biliary passages in order of their frequency: (1) fistula between the gastrointestinal tract and biliary tract; (2) atony of the common duct resulting in patency of the sphincter of Oddi; (3) a common duct terminating in the duodenal bulb (extremely rare).

The abnormal reflux of the contrast medium into the biliary tract may be placed in one of the above categories by the pattern demonstrated on the roentgen examination. In (1) the fistula usually opens into the duodenum and the lower part of the biliary tract is not filled; in (2) the entire bile duct is visualized.

Patency of sphincter of Oddi may be due to (a) calculi in the common duct; (b) cholecystitis; (c) pancreatitis; (d) pancreatic cancer; (e) enlarged pancreas; (f) gastric cancer; (g) duodenal ulcer; (h) adhesions between the duodenum and gallbladder; (i) scar formation of papilla of Vater; and (j) previous surgery.

The fistula between the biliary tract and the duodenum may be the result of: (a) perforation of gallstone; (b) surgery; (c) gastric and pancreatic cancer; and (d) liver abscess and hydatid cyst. These fistulas are usually found between the gallbladder and duodenum or duodenum and common duct and, less frequently, between the gallbladder and colon as demonstrated by barium enema examination. The author points out that air as well as contrast medium may be seen in the biliary tract without any relation to the barium meal. This may be due to: (1) gas forming organism; (2) patency of the sphincter of Oddi; and (3) a fistula between the gastrointestinal tract and the biliary tract.—*John Watts, M.D.*

KLAMI, PAAVO. On the visualization of ulcerative processes using hydrogen peroxide in the contrast medium; preliminary report. *Acta radiol.*, Feb., 1953, *39*, 98–104.

In internal organs, the presence of blood or pus is indicative of a pathologic ulcerative process. Both blood and pus will break down hydrogen peroxide with liberation of oxygen. Therefore, if hydrogen peroxide is present in the area of an ulcerative process, the resultant foam formation can be recognized either endoscopically or by roentgen examination.

In about 40 cases of esophageal and gastric roentgenographies, using a barium mixture containing 3 per cent hydrogen peroxide, foam formation was demonstrated in instances of ulcers, including the ulcerative carcinomas. The method has no differential value in the diagnosis of malignant disease, and in the presence of carcinoma without ulcer the appearance is no different than with an ordinary barium mixture.

In gastric examinations the method adds nothing of practical significance, but in narrow passages, such as the esophagus, it may prove to be of value. if a suitable opaque medium (other than the organic iodine compound now used) for examination of the upper urinary tract can be found, it may be applicable to retrograde study of kidneys and ureters.—*Lois Cowan Collins, M.D.*

AXLER, MORTON M., and REHERMANN, ROBERT L. Partial eventration of the right diaphragm. *J. Pediat.*, March, 1953, *42*, 320–324.

Eventration of the diaphragm is a relatively rare condition in which a portion of the diaphragm is elevated without loss of continuity of the muscle. Its etiology is not known, but is believed to occur as both a congenital and acquired lesion.

The authors present a case of partial eventration of the right side of the diaphragm which occurred in a five year old white male. He was known to have a mass in the right hemithorax of unknown nature since the age of nine weeks. The physical examination disclosed depression of the anterior wall and lower left side of the chest. The xiphoid protruded considerably.

Fluoroscopic and roentgenographic studies revealed a smooth ovoid mass of homogeneous density approximately 4×5 cm. in diameter in the right cardiophrenic sulcus. It was inseparable from the right atrial margin of the cardiac silhouette. The subjacent portion of the diaphragm was intact and moved with normal amplitude of excursion. The mass did not pulsate. There was no displacement of the esophagus.

Exploratory thoracotomy revealed a bulge 4×5 cm. close to the right pericardial edge. The diaphragm appeared to be continuous and the portion overlying the mass was found to be a fibrous layer. The mass beneath the diaphragm appeared to be normal liver tissue.

Inflammation, trauma and congenital developmental anomalies have been cited as possible etiological factors. The authors believe that the asymptomatic cases probably need no treatment. Where symptoms exist, exploratory thoracotomy should be considered.—*James F. Martin, M.D.*

LINDGREN, ERIK. Technique of abdominal aortography. *Acta radiol.*, March, 1953, *39*, 205–218.

The author discusses various techniques of lumbar aortography and considers the advantages and dangers of each.

The method most frequently employed is that originally suggested by Dos Santos. The patient lies in the prone position and the puncture is made immediately

under the twelfth rib, four fingerbreadths to the left of the midline. The needle is inserted obliquely upwards and inwards with the shaft tangential to the vertebral column. The point of the needle may be so directed that it first touches a vertebra and then shifted ventrally until it slides past the body of the vertebra. If the bevel of the needle does not lie completely in the lumen of the aorta paravascular injection may occur. Several factors which result in displacement of the bevel of the needle are discussed.

Fatal mesenteric thrombosis and parenchymal renal necrosis have occurred as complications when vessels other than the aorta have been injected. These have resulted more from unsuitable contrast media than from the sites of injection.

The author recommends the following technique if direct percutaneous injection is made: When the aorta is punctured and blood flows, a slender metal stylet is introduced into the lumen of the needle. A stop-screw on the stylet permits the stylet to be inserted so that its tip will lie in the mouth of the bevel. The stop-screw is then moved back a few millimeters and the stylet advanced. The distance from the tip of the needle to the opposite aortic wall is determined and should be from 4 to 5 mm. When it is possible to advance the stylet 1 cm. or more it means that a vessel other than the aorta has been punctured. A preliminary roentgenogram with a small quantity of contrast material can be made as a test for the position of the tip of the needle.

Because of the hazards associated with direct puncture, Fariñas employs retrograde abdominal aortography in which he exposes the femoral artery, inserts a catheter into the aorta and injects the contrast medium into the catheter. Euler punctures the aorta through the esophageal wall via an esophagoscope. Another technique consist in the passage of a catheter into the exposed radial artery and then into the aorta. A modification of Dos Santos's method consists of exposing the femoral artery through a small incision and inserting a curved trocar percutaneously 2 cm. distal to the incision. The trocar is guided into the vessel by inserting one finger into the incision. The catheter is then introduced into the trocar and the injection made.

Besides visualization of the renal arteries the increased density of the renal parenchyma, called the nephrographic effect, is of considerable importance. Relatively rapid injection is necessary to obtain good visualization of the renal parenchyma. The author employs a 50 cc. syringe mounted in a plastic holder Compressed air operates the plunger of the syringe. The air is not in contact with the fluid and a constant pressure is maintained during the injection. A contactor controls the exposure and the operator does not have to remain in the field of the roentgen beam.

The author prefers 70 per cent water-soluble contrast media of the umbradil, diodrast and diodone type to from 80 to 100 per cent solutions of sodium iodide. In light patients, even a 50 per cent solution may prove satisfactory. The quantity employed should be approximately 40 cc. injected within a maximum period of from six to seven seconds.

Either local or general anesthesia may be employed but the author prefers general anesthesia, if possible, in order to obtain some lowering of the blood pressure. The nephrographic effect will be greater if the blood pressure is low. The roentgenograms should be made with high kilovoltage and with as short an exposure time as possible. The first roentgenogram is exposed after 20 cc. of the contrast medium has been injected. The aorta and its branches are seen on this film. The cassettes should be changed within the next two seconds. Following this, exposures may be made at intervals of several seconds. The veins are not visualized until after approximately every fifteen seconds.

Aortography is contraindicated by hypersensitivity to the contrast medium and by impaired renal function. The day before the examination the patient should be tested by the intravenous injection of 2 cc. of the contrast material.—*J. N. Ané, M.D.*

Shore, Samuel, Jacob, Harry H., and Cannon, Jack A. Intestinal obstruction resulting from biliary calculi (gallstone ileus). *A.M.A. Arch. Surg.*, March, 1953, *66*, 301–311.

Intestinal obstruction resulting from biliary calculi occurs more commonly than was previously believed. The diagnosis of gallstone ileus should be considered in all cases of small bowel obstruction encountered in elderly women who have had no previous abdominal operation.

The visualization of air in the biliary tree by means of a roentgenogram of the abdomen is diagnostic of a cholecystoenteric or choledochoenteric fistula.

If a faceted stone is found obstructing the intestine, a matching stone should be sought in the gallbladder and removed. If the matching stone is not located in the gallbladder, the proximal small bowel should be explored.—*F. B. Markunas, M.D.*

Joris, Emile. Deux années de manométrie et de radiographie biliaires; résumé d'un étude de 130 cas. (Two years of manometry and roentgenography of the biliary system; summary of a study of 130 cases.) *Acta chir. belg.*, Feb., 1953, *52*, 130–168.

Surgery of the biliary tracts has undergone a new birth. This is not because of striking changes in surgical technique, but because of new investigative techniques employed during operation. The author used the technique of Mallet-Guy. The operating table is a simple wooden table in which the area supporting the thoraco-abdominal region is permeable to roentgen rays. Palpation of the gallbladder and biliary tract precedes any manipulation. When this

viscus does not appear diseased, the trocar puncture of Mallet-Guy is used and manometry and roentgenography are employed. In 92 per cent of the cases, the gallbladder was removed. In the others, the puncture was made through a tiny hole and the organ preserved.

An intracholedochal examination is admitted to be preferable. The trocar is placed into the dissected common duct well beyond the sphincter of Lutkens; sometimes a smaller trocar than that of Mallet-Guy must be used. The caliber of the tube influences the graphic records, but when the same tube is used, records in different cases are comparable. For manometry, a physiologic sodium chloride solution is injected into a Y-tube, one limb going to the biliary tract, the other to a recording tambour. Roentgenography consists of two films made at three minute intervals with 20 cc. of umbradil 30 per cent, during apnea produced by the anesthetist by hyperventilation.

Out of the operative cases available for study, 70 per cent were considered perfect postoperative results, 25 per cent satisfactory and 5 per cent failures which were largely biliary hypotonia.

Manometry and roentgenography during operation can give very valuable information. In cholelithiasis, the diagnosis is confirmed, and sometimes a stone is demonstrated when it was not otherwise apparent. A superimposed functional disturbance may be demonstrated. In 6 per cent of the cases common duct stones were found which were not suspected and had not been found by common duct exploration. In tumors of the head of the pancreas, the site and degree of obstruction of the common duct is established. However, it is in the functional syndrome without calculus that the method is invaluable. It is particularly important in deciding whether to add a right vagotomy to a cholecystectomy. By vagal infiltration or by using magnesium sulfate, hypertonia is diagnosed, whether fixed or labile. When the obstruction is organic, sphincterotomy may be indicated and result in cure.—*Marcy L. Sussman*, M.D.

HILÁRIO, JOSÉ, and PINTO, FRANCISCO. A colangiografia operatória. (Operative cholangiography.) *Rev. brasil. de gastroenterol.*, Jan.–Feb., 1953, *5*, 59–68.

The authors use cholangiography in biliary surgery as a routine method by following the technique introduced by Mirrizzi in 1930. As contrast medium they employ lipiodol (40 per cent solution) or nosylan.

In the interpretation of the roentgenographic image either the classification of Mirrizzi (oddditis, pancreatitis and lithiasis) or the system of Urrutia is used. The latter distinguishes the following five categories:

1. Free passage of the contrast medium into the duodenum; no visualization of the choledochus;
2. Free passage of the contrast medium into the duodenum; visualization of the choledochus with little stasis; no visualization of the hepatic system;
3. Limited passage of the contrast medium into the duodenum; dilatation of the choledochus with retention; visualization of the hepaticus; response to trinitrin;
4. Limited passage of the contrast medium into the duodenum; dilatation of the choledochus with retention; system of the hepaticus visualized and dilated; no response to trinitrin;
5. No passage of the contrast medium into the duodenum; dilatation of the choledochus; dilatation of the system of the hepaticus.

The information furnished by cholangiography may be anatomic, functional or therapeutic. Anatomically, the contrast medium visualizes the biliary extrahepatic tract from the system of the hepaticus to the papilla and so demonstrates the normal or abnormal conditions of the biliary tract, localizes pathologic lesions, compression, distortion (for instance, by tumors of the pancreas or of the liver), presence of biliary calculi, etc. Functionally, the degree of dilatation or reflux into the intrahepatic biliary tract through Wirsung's duct and the passage of the contrast medium into the duodenum as well as disturbances in the extrahepatic biliary tract are demonstrated. Therapeutically, cholangiography allows the simultaneous use of medicaments as, for instance, amyl nitrite, atropine, morphine, novocaine and similar drugs.

Operative cholangiography, in addition that it gives better information, is also less dangerous than instrumental exploration, Kocher's maneuver and other types of dissection of the biliary tract. The roentgenologic disadvantages are compensated by the possibility of more detailed exploration and by the opportunity of correcting the existing lesions during the same operative act, thus avoiding the frequent necessity of repeated interventions. Toxic phenomena due to the contrast medium were never observed in the authors' experiences extending over five years.—*Ernst A. Schmidt, M.D.*

LEGER, LUCIEN, and LATASTE, JACQUES. Le drainage du canal de Wirsung dans la pancréatite aiguë; réflexions sur la pathogénie de cette affection. (Drainage of the duct of Wirsung in acute pancreatitis; reflections on the pathogenesis of this disease.) *Presse méd.*, March 25, 1953, *61*, 445–448.

A single case is reported, serving as a basis for the interpretation of experimental work in animals and the numerous clinical observations on drainage of the duct of Wirsung along with roentgenologic visualization performed in various chronic diseases of the pancreas. The patient on operation was found to have a typical acute hemorrhagic pancreatitis with a

hematoma in the head of the pancreas. Duodenotomy in the second portion was done. Ordinarily, the papilla can be located without difficulty because of the spontaneous ejaculation of bile. In this case, repeated attempts at canalization were necessary because there seemed to be an obstacle. However, once this was passed, free flow of pancreatic juice into the duodenum occurred. There was no evidence of calculus. There was no biliary reflux. The gallbladder was sclerotic with a whitish wall.

The duct of Wirsung was drained, and the usual drug therapy instituted. Details of the chemical analysis of the pancreatic juice made every day are given. On the fourth day, 3 cc. diodone was instilled and several roentgenograms were made. There was the usual duodenal reflux, relieved by the withdrawal of some of the contrast material. The duct was outlined completely without any breaks. In the tail, the afferent canaliculi were perhaps fuller than usual but this might be due to the fact that the polyethylene catheter had been introduced well into the gland. Suppression of drainage occurred on the seventh day followed by cure.

It had been expected that the duct of Wirsung would be irregular possibly communicating with small abscesses. This, however, was not found. For this reason, the current theories of pathogenesis are questioned. These theories are reviewed and the objections listed. The practical conclusion of the discussion is that when there is obstruction, drainage of the duct of Wirsung is helpful but where no obstruction exists, the procedure may be debatable. But even in the latter situation, the authors wonder whether the more rapid evacuation of an autolytic agent in the pancreatic juice, by drainage, might not be beneficial.—*Marcy L. Sussman, M.D.*

Baronchelli, A., and Rossi, L. L'applicazione del retropneumoperitoneo associato alla stratigrafia nello studio dell'addome metapleuritico. (Retropneumoperitoneum and stratigraphy in the study of the metapleuritic abdomen.) *Ann. radiol. diag.*, 1952–1953, *25*, 7–25.

A group of 10 patients with a clinical diagnosis of metapleuritic abdomen were studied with plain roentgenograms supplemented with laminagrams after retropneumoperitoneum. By this method adhesions, enlarged lymph nodes and obliterated spaces in the retroperitoneal area could be demonstrated. This was due to the fact that the oxygen introduced into the retroperitoneal space was not able to delineate the kidneys, liver or spleen as it usually does in an unaffected case. Not only was the pathology demonstrated as to its location but also its extent. The authors feel that they were able to confirm the clinical diagnosis by this method and somewhat add to the etiology of this syndrome.

By demonstrating this pathology roentgenographically the patients are spared surgical procedures since this syndrome may closely imitate diseases of the gallbladder, appendix or colon.

The authors feel that the disease starts primarily in the pleura and by lymphangitic spread invades the serosa on either side of the diaphragm extending to the peritoneum.

Three cases are reported in detail and the illustrations included in the article are convincing.

This syndrome described by Campanacci has an insidious onset which progressively becomes more painful, usually afflicting the hyposthenic adult female with upper abdominal pain usually localized to the right upper abdomen.—*Peter E. Russo, M.D.*

Bonomini, Bruno. Duodeno, pancreas, peduncolo epatico, studiati con l'associazione stratigrafia e pneumoretroperitoneo. (Duodenum, pancreas and suspensory ligament of the liver studied by retropneumoperitoneum and stratigraphy.) *Ann. radiol. diag.*, 1952–1953, *25*, 73–88.

In 1950 the author reported how this combined method, retropneumoperitoneum and stratigraphy (laminagraphy), can be used successfully for the visualization of the retroperitoneal organs including the pancreas. He has continued this line of investigation especially to find out if the head, body and tail of the pancreas could be clearly demarcated. By introducing an effervescent powder or barium mixture into the upper gastrointestinal tract, the duodenal loop can be outlined by a double contrast, since free air will collect about its serosal surface. Hence, any deformity or alteration of the duodenum can be detected including any tumor mass which may be present in that area.

The author states that this method opens up a new field of investigation for diseases of the pancreas. Numerous studies were conducted on subjects who did not have any disease of the pancreas to determine the normal relationship of the organ and its variations. In addition, 4 patients with the following pathologic conditions were examined: a large cyst of the body and a small cyst of the tail of the pancreas, a chronic pancreatitis and a lipomatosis of the head of the pancreas.

The value of this method is of great practical importance. The returns for the efforts, which are time consuming and require considerable exposure to the patient, are high and fully warrant its use in well selected cases.

The author includes numerous excellent illustrations.—*Peter E. Russo, M.D.*

Castellani, F. Rene policistico e retropneumoperitoneo. (Polycystic kidneys and retropneumoperitoneum.) *Ann. radiol. diag.*, 1952–1953, *25*, 149–162.

Usually the diagnosis of polycystic kidneys presents no real problem, especially when the patient has a typical clinical history and the excretory pyleograms show the usual changes. Cases are encountered, however, which are on the borderline and in which a correct diagnosis may be difficult to establish.

The author examined three such cases. By using retropneumoperitoneum the kidney shadows were sharply demarcated, showing the enlarged and irregular kidney outline. In all of the illustrations included in the article, the numerous cysts of the kidneys can be clearly seen.

This method offers another simple diagnostic procedure which will prove very useful in detecting renal pathology.—*Peter E. Russo, M.D.*

Genitourinary System

Baker, Roger. Studies on cancer prevention in urology. I. Prostate. *Ann. Surg.*, Jan., 1953, *137*, 29–35.

This paper deals with the measures available to reduce the incidence of urological cancer and specifically with the dangers of activating quiescent prostatic carcinoma by the therapeutic use of testosterone.

Cancer in urological patients has been increasing in absolute incidence and in relation to nonmalignant diseases. In 1948, cancer of the genitourinary tract, exclusive of female genital system, accounted for 15.4 per cent of all cancer deaths.

Until a cure for cancer is attained any reasonable procedure to reduce the incidence of cancer should be used. Cancer of the renal pelvis tends to develop in the ureter and bladder of the same side, therefore excision of all of the ureter and a cuff of the bladder is recommended with nephrectomy. The preoperative distinction between simple renal cyst and carcinoma as a surgical consideration is unwarranted as malignancy may be present in the bases of some renal cysts. It is better to explore all renal cysts surgically. The relationships of cystitis cystica, leukoplakia, benign papillomas of the bladder, aniline dyes, and circumcision to urological cancer are also discussed.

Although the incidence of prostatic cancer in men over fifty years is accepted as 10 per cent, careful routine autopsies have revealed an incidence of 24 per cent. Daily amounts of estrogen, as small as 0.25 mg., will inactivate advanced prostatic cancer but this effect may be neutralized with 10 mg. of testosterone proprionate daily. Therefore the administration of testosterone proprionate as a therapeutic agent for any condition is inadvisable in men over forty-five years of age. Even small doses of testosterone are to be condemned as the hormonal control of prostatic cancer is so delicately balanced.—*John F. Weigen, M.D.*

Charan, A. Diffuse phlebosclerosis with calcification. *Brit. M. J.*, Jan. 10, 1953, *1*, 80–81.

This report describes a male, aged twenty, who entered the hospital for treatment of urinary tract complaints attributed to calculi. Bilateral vascular calcification was noted in the antecubital and popliteal areas. These radiopaque cord-like shadows were found to be veins. A specimen was excised from the left arm and microscopic verification was obtained.

While doing a right pyelolithotomy, calcification of the renal veins was noted. Study for parathyroid disturbance revealed no abnormality. There was no parasitic disease.

Various authors have reported rare instances of phlebosclerosis since 1905. Most patients described were twenty to forty years of age when seen and showed bilateral superficial and deep venous calcification.

There is no close relation of this condition to arteriosclerosis or infection. Some observers believe phlebosclerosis is more likely to occur in patients who have peptic ulcer, gout, lead poisoning or syphilis.—*John W. Turner, M.D.*

Garnung, H., Favier, M., Vailhe, J., Roumagnac, H., and Delmas, J. De l'intérêt de l'urographie intraveineuse dans les albuminuries juvéniles isolées. (The value of intravenous urography in isolated juvenile albuminurias.) *Presse méd.*, March 7, 1953, *61*, 323.

The authors investigated by intravenous urography 49 cases of isolated juvenile albuminuria. All of their patients were between twenty and twenty-three years of age, had no previous history of renal disease, and showed no impairment of urinary function. In about 50 per cent of the cases the albuminuria has been disregarded entirely and in 25 per cent it was discovered only on routine physical examination. In two-thirds of the cases it was orthostatic or postprandial.

The authors found 20 cases of abnormalities of the urinary tract. In 17 there were congenital malformations of the urinary system; in 11 pyelectasis was present; there were 4 cases of bifid ureteral or pyeloureteral systems and in 2 cases there was renal hyperplasia. In 5 cases the abnormality was confined to the left side, in 6 cases to the right side and in 6 cases it was bilateral. In addition to these 17, there were 2 cases of proved, and 1 case of probable renal tuberculosis.

The authors believe that it is important to study any case of juvenile albuminuria in order to determine whether pathological conditions or anomalies are present in the renal system, or whether the albuminuria is without clinical significance.—*Angus K. Wilson, M.D.*

Cereseto, Pedro L. Abscesos perirrenales. (Perirenal abscess.) *Prensa méd. argent.*, Jan. 9, 1953, *40*, 101–104.

In a study based on 7 patients, 6 acute and 1 chronic, all of whom came to operation, the etiology was varied. Two cases had suffered from furunculosis three weeks and two months before the appearance of the lumbar symptoms. In other cases there was a history of direct relation to sudden muscular effort, with pain localized in the lumbar zone on the side on which the abscess subsequently appeared. One patient had retrocecal appendicitis. One case had renal echinococcosis. The lesion was a clean renal hydatid cyst, without pain, and without communication with the renal pelvis. The day following catheterization of the pelvis of the kidney there was a painful infiltration of the lumbar zone, occurring the next day and terminating on the eighth day in a frank perirenal abscess, with organisms of the coli type. The author believes the catheter irritated the kidney and the opaque medium started mobilization of the coli infection by way of the lymphatics. The danger of catheterization in this type of infection has been previously emphasized by L. G. Lewis.

The roentgen findings are described as follows: lumbar scoliosis with concavity directed toward the affected zone; obscurity of the psoas muscle shadow; elevation of the diaphragm on the affected side; fixation of the diaphragm, determined fluoroscopically. The pyelograms show displacement of the pyelocalyceal shadow or a separation of the calyces which seem to be blunted as with a tumor. Some cases exhibit stasis in the renal pelvis with some tardiness in clearance of the opaque material. This finding may be noted both with retrograde and with intravenous pyelography. Finally, a diagnostic means employable in some cases, but not in all, is retroperitoneal emphysema.—*James T. Case, M.D.*

Walldén, Lennart. Roentgen examination of the deep rectogenital pouch. *Acta radiol.*, Feb., 1953, *39*, 105–116.

The rectogenital pouch is the most inferior portion of the peritoneal cavity, and in the adult generally forms a "fissuriform" space between the rectum and the intrapelvic genital organs, with its lower margin at about the level of the posterior vaginal fornix or upper border of the prostate.

The pouch is deep and wide in the early stages of intrauterine development, but gradually obliteration of the deeper portions of the pouch occurs during the latter part of intrauterine life.

Varying degrees of nonobliteration of the deep rectogenital pouch occur in both men and women. In young individuals, small intestine projects into and fills the deep rectogenital pouch during straining only, but in older subjects the filling may become a permanent condition. The degree of variation in depth of the rectogenital pouch is great. It may come down to the pelvic floor, or protrude through it in hernial-like bulges, or in some instances project into vagina or rectum, and occasionally protrude through the anus as a true rectal prolapse.

Such anatomic anomalies are often associated with a defecation disorder, termed defecation block, characterized by a sensation that the rectum is blocked while straining at stool.

Roentgenographic studies of the pelvis with rectum, and again with small intestine, demonstrated with barium, were made on 12 men and 29 women complaining of defecation block, and also on a control series of 104 healthy subjects.

Roentgenograms were taken with the patient erect With the rectum and rectosigmoid filled, examinations were made in the anteroposterior and lateral positions, with and without straining, and similar roentgenograms made after the rectum and sigmoid had been cleared of barium and the pelvic portion of small intestine filled.

The roentgenologic signs of deep rectogenital pouch with varying degrees of protrusion of small intestine into it were confirmed by laparotomy in 28 cases of defecation block. This is a practical method for demonstrating the anatomy of the rectogenital pouch in cases with defecation disorder.—*Lois Cowan Collins, M.D.*

Ross, J. Cosbie, and Damanski, M. Pudendal neurectomy in the treatment of the bladder in spinal injury. *Brit. J. Urol.*, March, 1953, *25*, 45–50.

This is a report of the results of pudendal nerve sections in 11 cases of paraplegias in an effort to obtain automatic bladder emptying. Successful results were obtained in 8 cases. It is recommended that this operation not be performed during the early stages of the disability.

The selection of the cases depends largely upon urethrocystography. If no organic obstruction is found at the bladder outlet the overaction of one or both sphincters is assured and pudendal neurectomy is indicated. *J. H. Harris, M.D.*

Hodgkinson, C. P. Relationships of the female urethra and bladder in urinary stress incontinence. *Am. J. Obst. & Gynec.*, March, 1953, *65*, 560–573.

Urinary stress incontinence in women is a problem without precise definition. Clinical evidence suggests that alterations in the relationship of the urethra and bladder play an important role in female stress incontinence. This report is to present results of a modified urethrocystographic technique which permits roentgenographic demonstration of the bladder outline and the entire undistorted urethra. Instead of a semirigid catheter, a metallic bead chain, of the type commonly used for carrying keys, was used to study urethral configuration. The method has the

advantages of simplicity, accuracy of detail, freedom from distortion, and excellent roentgenographic contrast in both the anteroposterior and lateral positions.

For purposes of comparison, three groups of patients were studied. The normal group demonstrated that urinary continence was a function of adequate sphincter activity for control and release of intravesical hydrostatic pressure. Continent multiparas with various degrees of bladder-floor relaxation demonstrated backward and downward rotation of the bladder with relative elevation of the internal urinary meatus along the anterior bladder wall. In such instance the internal urinary meatus was removed from the area of maximum hydrostatic pressure.

Patients suffering from urinary stress incontinence demonstrated downward vertical thrust of the bladder and urethra without rotation. The internal urinary meatus in patients with stress incontinence remained in the area of maximum hydrostatic pressure during the straining effort. These studies demonstrated that the Kennedy procedure produced restoration of normal anatomy. Success of the operation depended upon proper repair of the sphincter mechanism.

This method of study of the relationships of the urethra and bladder demonstrates several advantages. The patients were studied in the standing position. Roentgen detail was clear in both the anteroposterior and lateral positions. Undistorted urethral configuration was obtained under conditions of rest and strain. The method was easy to learn and simple in application.—*Eugene J. McDonald, M.D.*

Skeletal System

Ellis, V. H. The diagnosis of shoulder lesions due to injuries of the rotator cuff. *J. Bone & Joint Surg.*, Feb., 1953, *35-B*, 72–74.

The diagnosis of tears of the rotator cuff of the shoulder by clinical examination presents considerable difficulty. This article is an attempt by the author to assess the value of two procedures: procaine injection of the tender area over the tip of the humeral tuberosity in recent injuries and arthrography.

Patients suspected of a recent injury of the rotator cuff on clinical grounds are subjected to an injection of procaine. If this restores the power of voluntary abduction, up to 150 degrees or more, it is considered that a major lesion is unlikely and treatment is conservative. If injection does not increase the voluntary range, arthrography is performed. The technique involves the insertion of a short-bevelled needle through the clean skin 1 inch in front of the acromioclavicular joint. The needle is directed downwards and backwards into the cartilage of the humeral head. Thirty per cent diodine is injected under roentgenoscopic control. If the opaque fluid enters the joint, but immediately flows out into the subacromial bursa, it is considered that there must be a large tear requiring operative repair. Procaine injection is confined to early lesions.

Arthrography was employed for 42 suspected major tears. Of these, 22 were considered to show major tears; 15 were operated upon; 7 either refused or were unsuitable on account of age or other factors. In 14 operations, the arthrographic findings were confirmed. In the exceptional case, the patient had probably dislocated his shoulder and had contused the supraspinatus. More than half of the patients recovered good movement and power and lost their pain. The 7 patients who did not have the operation failed in every case to recover and only 2 were improved.

A negative arthrogram, or a plain roentgenogram showing an avulsion crack in the greater tuberosity, was obtained on 20 occasions. Fifteen of these patients recovered completely; 2 others were operated upon for pain and the presence of a minor lesion was confirmed. The author considers that negative arthrography is a good contraindication to operation, unless other factors require it.—*Ralph S. Bromer, M.D.*

Knetsch, Alfons. Das sternale Schlüsselbeinende im Röntgenbild. (Roentgen appearance of the sternal end of the clavicle.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Jan., 1953, *78*, 70–75.

According to the author, grooves are found at the sternal end of both clavicles in 12.2 per cent of all chest survey films. These grooves are known as rhomboid fossae. Since occasionally they have a sclerosed margin and a somewhat irregular bone structure, the author assumes that they are the seat of aseptic necrosis. No histologic or clinical findings are given to support this assumption.

The article is illustrated with five roentgenographic reproductions.—*Albert Oppenheimer, M.D.*

Françon, F., Faidherbe, P., Du Lac, G., and Leblanc, G. Le comportement de l'articulation manubrio-sternale dans la spondylarthrite ankylosante (ex-spondylose rhizomélique). (Behavior of the manubriosternal articulation in ankylosing spondylarthritis [so-called rhizomelic spondylosis].) *Presse méd.*, Jan. 28, 1953, *61*, 109–111.

After a concise review of the pathology and anatomy of the manubriosternal articulation, the authors present 9 clinical cases of ankylosing spondylarthritis, 8 of which showed involvement of the articulation.

Often no clinical symptoms referable to this articulation are present, but roentgenographic examination demonstrates its involvement. A true lateral view

with special care to keep the scapulae posteriorly gives the best roentgenographic visualization of the manubriosternal articulation.

Of the 9 patients with spondylarthritis (all of whom were men of the ages of 28 to 58 years) 1 had complete ankylosis of the articulation, 3 had incomplete fusion; 1 had a beginning ossification of the anterior and posterior ligaments; 2 had an erosion of the osseous borders and 1 had discrete erosion.

The involvement of the sacroiliac articulations and of the symphysis pubis in the same disease is also noted.

Of the various treatments, roentgen therapy is mentioned as being favorable.—*J. N. Sarian, M.D.*

Jack, Ewen A. Naviculo-cuneiform fusion in the treatment of flat foot. *J. Bone & Joint Surg.*, Feb., 1953, *35-B*, 75–82.

The author asserts two main premises in the introduction to the article on which his work was based. Flat foot of severe degree is a disabling condition which causes restriction of activity in young adults and induces morbidity in later life. Correction of the deformity by operation in young patients is worth while if it is possible. The medial longitudinal arch of the foot and therefore the posture of the foot depend upon the intrinsic structure of the bones and joints and the integrity of the plantar ligaments.

In the normal weight-bearing foot the axes of talus, navicular, medial cuneiform and first metatarsal form a straight line. Theoretically sag may occur at one or all of three points—the three joints which link the segments of the arch. It is possible to demonstrate roentgenographically the anatomical situation of the break in the arch. Lateral roentgenograms of the foot must be taken with the patient standing erect with his muscles relaxed as far as possible. Collaboration of the roentgenologist is essential in insuring the relaxed position when exposure is made. It is helpful to have a simple stand and cassette holder so that a standard position and technique can be adopted.

Roentgenological investigation showed that the cases of flat foot deformity form three distinct anatomical types according to the precise level of the break in the arch. The metatarso-cuneiform joint never gives way. The break may occur at the naviculo-cuneiform joint alone, or there may be a break at the naviculo-cuneiform joint, or there may be relaxation at both these joints in a combined sag. Determination of the site of the break in the arch is most reliably achieved by drawing a line through the axis of the navicular. It can then be seen whether angulation occurs proximal or distal to the navicular, or at both situations.

When the break occurs at the naviculo-cuneiform joint alone, fusion of this joint in normal alignment should correct the deformity. The results of operation on 46 feet are analyzed in the article. Eighty-two per cent proved satisfactory. Failures are discussed and are considered avoidable by careful selection and operative techniques.—*Ralph S. Bromer, M.D.*

Warrick, C. K., and Bremner, A. E. Fractures of the calcaneum; with an atlas illustrating the various types of fracture. *J. Bone & Joint Surg.*, Feb., 1953, *35-B*, 33–45.

The authors consider that a necessary preliminary to the application of any form of treatment of fractures of the calcaneum is an accurate description of the course of the main lines of fracture and the displacement of the principal fragments. With this in view they have classified a large series of recent fractures of the calcaneum and have studied particularly the mechanism of the compression-shearing injuries and the fracture patterns they usually produce.

The fractures are divided into two groups: Group I consists of isolated fractures of the anterior end of the bone; isolated fractures of the sustentaculum tali; fractures of the tuberosity, either of a beak or vertical type. Group II consists of compression-shearing fractures; either with division of the bone into two main fragments only or with division of the bone into two main fragments and secondary compression of the main lateral fragment. The second group is further subdivided depending on the segment or part of the bone which is involved.

The three projections used in the roentgenographic examination are the lateral, the axial and the oblique view described by Anthonsen. In the oblique view, the bone is projected obliquely, the foot is dorsiflexed and is placed in the lateral projection on the film and the ray is directed to a point just below the medial malleolus with an angulation of 25 degrees towards the foot of the table and 30 degrees toward the toes (dorsiventrally). The ray strikes the posterior articular facet tangentially and passes in the direction of the long axis of the sulcus calcanei. The use of the Potter-Bucky diaphragm is recommended.

The article is illustrated with 38 figures consisting of roentgenographic reproductions, photographs of the calcaneum with fracture sites shown in color, and an illustration of the technique used in obtaining the oblique view of the calcaneum.—*Ralph S. Bromer, M.D.*

Stein, Heinr. Über Rotationen von Wirbeln, eine röntgenanatomisch-klinische Studie. (Rotation of vertebrae; a roentgen anatomical-clinical study.) *Die Medizinische*, Jan. 31, 1953, 154–161.

Unexplained manifestations of pain, change in muscle tone and skin temperature, etc., may be associated with rotation of the vertebrae. At the site of the rotation, there are always osteochondrotic changes of the vertebral disc (localized spondylosis, spondyloarthrosis, and rupture of intervertebral disc).

Rotation is present, whenever the vertebral column twists to one side or the other. As a result, there is a step-like deviation of one vertebra upon another, in a ventral, dorsal, or lateral direction. This deviation may be for a distance only of millimeters.

A clear idea of rotation of a single vertebra in relation to clinical manifestations is lacking in the medical-roentgenological literature. Any disturbance of one of the structural elements produces damage to the entire framework. This does not necessarily lead to any clinical symptoms until mechanical factors bring unphysiological forces into play. Symptoms are noted in the early stages rather than in the far advanced cases of rotation. The vertebral body changes in contour, particularly along the periphery.

In rotation, osteophytes form on the apophyseal joints, and subluxation and localized spondyloarthrosis occurs. Displacement of the vertebra produces pressure on the intervertebral foramina and its contents. Functional disturbances of internal organs (kidneys, stomach, etc.) may be produced.

Lumbar puncture findings are usually normal although occasionally inflammatory changes are found. This has been explained by some as due to osteochrondrotic changes in intervertebral discs, but the author believes that localized arachnoiditis is the more probable cause.

Treatment is difficult. Prophylaxis with mechanical aids to prevent further damage is essential. Physiotherapy, in all its forms, may be of considerable aid. General therapy in the form of vitamins, hormones, etc., must not be neglected.

It can be shown that rotation of the vertebrae is not fixed and is subject to change. This condition is seen in the first decade as well as in the aged.

In summary, the author expounds the idea of "rotation of a single vertebra." A degenerated intervertebral disc is always present in such a condition. The presence of localized osteochrondrosis of a vertebra should always make one consider the possibility of rotation. This condition may be the cause of symptoms which simulate diseases of many internal organs.—*Samuel Richman, M.D.*

HASNER, E., JACOBSEN, H. H., SCHALIMTZEK, M., and SNORRASON, E. Lumbosacral transitional vertebrae; a clinical and roentgenologic study of 400 cases of low back pain. *Acta radiol.*, March, 1953, *39*, 225–230.

A roentgenographic study of 400 patients with low back pain revealed sacralization in 30 patients and lumbarization in 10 patients. Roentgenograms were taken with the patients in the sitting position with the spine flexed forward and backwards, respectively, and on maximum lateral bending.

The authors consider paradoxical angulation on lateral bending of the spine as evidence of disturbance of the balance of the lumbar spine. This was a frequent finding in cases of sacralization and lumbarization. In 9 of the 10 cases of lumbarization and in 15 of the 30 cases of sacralization narrowing of the fifth lumbar intervertebral disc was observed.

The authors conclude that the differentiation of cases of lumbosacral transitional vertebrae, from others with low back pain is impossible clinically and that the diagnosis can be made by roentgenography only.—*J. N. Ané, M.D.*

KNUTSSON, FOLKE. A qualitative comparison between the standard type of examination and tomography for certain intraosseous structural changes; Mackenzie Davidson Memorial Lecture. *Brit. J. Radiol.*, March, 1953, *26*, 113–121.

An attempt is made to determine the relative value of tomography (laminagraphy) in comparison with standard examination by plain roentgenograms in certain branches of skeletal diagnosis. It is understood that in some regions laminagraphy is used because it facilitates the examination and is more convenient, but not necessarily because it is essential in establishment of the diagnosis. The problem here investigated is: In the skeletal examination in question, can the standard method be held to result in the optimal diagnosis, or can the application of laminagraphy carry the diagnosis still further?

An isolated vertebral body was examined through various depths of water, to simulate the conditions found in examination of patients. Examination was made by both laminagraphy and by the standard methods. It was found that visualization of the state of structural pattern of the vertebral body is more satisfactorily shown in standard roentgenograms. Diffuse lesions, such as myeloma or diffuse metastases, are thus better shown by standard examination.

Subsequently, spherical defects were created in the cancellous bone. It was shown that a lesion 20 mm. in diameter is barely demonstrable in 6 cm. of water, and not at all at increasing depths, when examination is by standard roentgenographic methods. This lesion as well as one 15 mm. in diameter is clearly visible in as much as 20 cm. of water when examination is by laminagraphy. It appears that this result is a corollary of the first experiment: The fact that laminagraphy produces blurring of detail in cancellous bone permits better demonstration of the lesion.

A lesion of increased density was created and the construction was such that the density was variable. When the density was diminished until the lesion was no longer visible on the standard roentgenograms it was still clearly visible with laminagraphy.

A lesion of the cortex of a vertebra, on the other hand, is much better shown on standard roentgenograms.

Additional studies were made using the knee. It was found that laminagraphy is of much greater

value in demonstrating the exact position and extent of a depressed fracture of the tibia and also in demonstration of small fissure fractures leading into the joint.

It would appear that standard methods are satisfactorily accurate in routine use, if roentgenographic quality is optimal. When the diagnostic accuracy must be pressed to its limit, or when there is some question left by the standard method, the absolute superiority of laminagraphy based on purely physical grounds should be utilized. This is particularly valuable in demonstration of focal vertebral lesions of either increased or decreased density in cancellous bone, and in displaying certain injuries at the knee. —*E. F. Lang, M.D.*

Kaplan, C. J. Cervical hyperextension injuries with paraplegia. *J. Bone & Joint Surg.*, Feb., 1953, *35-B*, 97–100.

In this article the literature on paraplegia complicating hyperextension injuries of the cervical spine is reviewed, and notation is made of the lack of any definite explanation of the mode of interference with cord function. A case is reported of a man, aged fifty-four, who sustained a severe trauma when overthrown by a wave while sea-bathing. A complete paraplegia extending upward to the level of the seventh cervical vertebra developed. Roentgenograms showed marginal osteophytes on the bodies of the fourth, fifth, sixth and seventh cervical vertebrae. An osteophyte at the anterior inferior margin of the body of the fourth vertebra appeared to be fractured. In the anteroposterior projection there was a suggestion of an increased gap between the fifth and sixth cervical vertebrae. A diagnosis of hypreextension injury was made. Death occurred seven days after the injury.

On the basis of findings at autopsy, the author suggests that one cause of the suppression of cord function in such injuries is thrombosis of the spinal arteries and liquefaction-necrosis of the cord.—*Ralph S. Bromer, M.D.*

Alexander, Eben, Masland, Richard, and Harris, Carlton. Anterior dislocation of first cervical vertebra simulating cerebral birth injury in infancy. *A.M.A. Am. J. Dis. Child.*, Feb., 1953, *85*, 173–181.

Chronic dislocation of the upper cervical spine with compression and degeneration of the cervical spinal cord may produce signs and symptoms which in the initial stages closely resemble those seen in cerebral birth palsy infants. In the case reported in this article death resulted from anterior dislocation of the atlas with fracture of the odontoid process. The patient had a slowly retrogressive course over a period of ten months, the diagnosis becoming apparent only at the terminal phase of the condition.

Roentgenograms of the skull and chest showed no significant changes. Films of cervical spine demonstrated forward displacement of the atlas on the axis with an indistinct outline of the body of the atlas. After injection of the opaque material, the column was found to be obstructed at the level of the first and second cervical bodies.

The authors believe that it is entirely likely that if abnormality of the cervical region had been discovered prior to the patient's admission to the hospital at twenty-one months of age, traction and reduction of the dislocation or surgical decompression might have been effective in restoring the function of the spinal cord to a relatively normal degree. An important clue to the noncerebral origin of the patient's disorder was to be found in the fact that he continued to show entirely normal mental development and a high degree of alertness at a time when progressive motor paralysis had reached a point of complete incapacity.—*Ralph S. Bromer, M.D.*

McCash, C. R., and Rowe, N. L. Acute osteomyelitis of the maxilla in infancy. *J. Bone & Joint Surg.*, Feb., 1953, *35-B*, 22–32.

Less than 100 cases of osteomyelitis of the maxilla in infancy have been reported in the English and American literature since it was first described by Rees in 1847, and the authors found only 13 cases reported since the introduction of penicillin. Before the introduction of chemotherapy, the mortality in this condition was estimated at between 25 and 30 per cent. In the last 13 cases reported, there has been only 1 death.

The disease is essentially an acute inflammation of the maxilla with a spreading thrombosis of its nutrient vessels, followed by sequestration of necrotic bone and tooth follicles. In mild cases, or when the acute phase has been cut short by early chemotherapy, the inflammatory process may subside without sequestration, but in the past such a clinical course has been exceptional. Most cases pursue a relatively chronic course, characterized by a short acute stage lasting a few days, which is followed by a stage of prolonged purulent discharge and sequestrum formation.

In the article the clinical features, diagnosis, surgical anatomy, pathology, and bacteriology are discussed and the constant pathogenicity of the *Staphylococcus aureus* is stressed. The authors suggest that the first deciduous molar tooth is the center of the early bone infection, and that the infection begins in the mucosa overlying this tooth. The clinical course of the disease is divided into two stages, and in the first, or early stage, roentgen examination is of no value, inasmuch as the osteoporosis induced by the pathological process takes about three weeks to develop.

Two cases are reported in full in the article. Both were caused by a penicillin-resistant staphylococcus. The early use of aureomycin in an attempt to abort the infection is advocated.—*Ralph S. Bromer, M.D.*

Jackson, Harris, Kessel, I., Javett, S. N., and Kushlick, P. Typhoid osteitis in infancy. *Arch. Dis. Childhood*, Feb., 1953, *28*, 19–23.

A review of the literature shows that osteomyelitis complicating typhoid is a relatively rare occurrence, especially in infants. It has been found that in the first decade of life typhoid osteomyelitis occurred in less than 1 per cent of cases in contrast to septic osteomyelitis which occurred in 26 per cent of the cases.

Two cases are presented. The first is that of a boy six months old, who, about sixteen days after the onset of a pyrexial illness with a macular eruption, developed painful symptoms in the left and then in the right shoulder with swelling and edema of the right shoulder and bilateral enlargement of the axillary lymph nodes. Roentgen examinations, made at intervals during the course of the illness, showed a thin irregular area of rarefaction in the metaphysis of the humeral head which became larger and more irregular and later developed a thin zone of marginal sclerosis with minimal subluxation. The sclerosis became more pronounced and the capital epiphysis became smaller and almost completely disappeared. Later regeneration of the head was noted which reappeared in fragmented fashion. The epiphyseal changes were attributed to direct invasion or avascular necrosis.

The second case, a girl ten months of age, was admitted to the hospital about four months after Case 1 with a history of fever for two weeks and refusal to move the left arm. On examination the temperature was normal and there was a hot, tender, painful swelling in the upper half of the left arm. Roentgen study showed soft tissue swelling with edema of the musculocutaneous plane. An area of rarefaction was noted in the humeral capital metaphysis. Later this area was more clearly defined with a linear sclerotic margin and minimal periosteal reaction. Three and a half months later, there was complete restitution to normal.

The authors summarize these cases as follows: Both infants were under one year of age. In each the high and rising titers of the agglutination reactions confirmed the clinical suggestion of typhoid. Both showed pseudoparalysis and edema of one or both upper extremities. The roentgenologic findings were similar with increasing rarefaction of the humeral head followed by a zone of bone sclerosis. Tuberculosis and syphilis were excluded by negative Mantoux reactions and serology. Both recovered under treatment by chloramphenicol.—*W. W. Maver, M.D.*

Sterne, Eugene H., Jr., and Schneider, Benjamin. Psoriatic arthritis. *Ann. Int. Med.*, March, 1953, *38*, 512–522.

Six cases of psoriasis are described associated with a peculiar type of arthritis. Of these, 4 are believed to be of a pure psoriatic type, and 2 a mixture of psoriatic and rhematoid types.

Psoriasis does appear to be associated with arthritis of a rheumatoid type to a significant statistical degree, although the figures vary considerably from series to series throughout the literature. Joints in close apposition to skin lesions show a particular susceptibility. In the true psoriatic arthritis the joints of the terminal phalanges of both fingers and toes are typically involved, but proximal interphalangeal, metatarsophalangeal, and metacarpophalangeal joints may show similar changes. There is also some correlation between the degree of nail involvement and the changes in the distal interphalangeal joints.

The roentgenographic findings are: periarticular swelling, destruction of articular surfaces, narrowing of the joint space, subarticular sclerosis or haziness, and a lack of the generalized osteoporosis which would be expected if the arthritis were of the rheumatoid type. Less commonly punched-out subarticular areas may be found. The destructive changes may progress until telescoping occurs. The most significant diagnostic features are the lack of expected osteoporosis and the subarticular sclerosis. These changes may also be found in certain stages of neurogenic arthritis and chronic connective tissue diseases —such as scleroderma, and dermatomyositis.—*William E. Craddock, M.D.*

Hurt, R. L. Osteopathia striata—Voorhoeve's disease; report of a case presenting the features of osteopathia striata and osteopetrosis. *J. Bone & Joint Surg.*, Feb., 1953, *35-B*, 89–96.

Osteopathia striata is a rare developmental abnormality characterized by striation of the skeleton, especially the metaphyses of the long bones. In the case reported in this article well marked striations were demonstrated throughout the limbs, which the author believes justifies the diagnosis of osteopathia striata. The skull and the ribs, however, showed the appearance of osteopetrosis, and he thinks it possible that the case may really be an atypical example of the latter disease.

The main roentgenographic features were longitudinal striation in all the long bones, an irregular fan-like striation in the ilium and a considerable increase in density of the skull and ribs. All the long bones showed thin irregular lines or striae, extending for a considerable distance into the metaphysis from the epiphyseal junction with the former. In some of the epiphyses there were a few small irregular densities. In the carpus there were small translucent areas scattered among abnormally dense bone. In both ilia there were many elongated dense areas arranged so as to give an irregular fan-like striation. Gross thickening of the cranial vault, with loss of differentiation into inner and outer tables was present in the

skull, and there were also one or two areas of dense bone projections into the cranial cavity. The base of the skull was thickened and the nasal accessory sinuses, except for the frontals, were obscured. All the ribs were dense and a few striae were found in the costal cartilages. There were scattered areas of increased density in the vertebral bodies, but there was no differentiation into upper and lower bands as seen typically in osteopetrosis, In the lumbar vertebrae there was a suggestion of vertical striation.

The segment of the rib which was removed was hard, so much so that considerable difficulty was encountered in cutting it at operation. Histopathological examination of the rib showed the typical structure of osteopetrosis. The lamellar structure of the bone was lost due to the obliteration of the canaliculi, and the isolated lacunae appeared small and empty.

The author thinks that it is difficult to determine whether his case should be classified as a case of osteopathia striata or as an atypical example of osteopetrosis. The striation in the long bones is identical with that described by Voorhoeve in his case and the rather irregular fan-like appearance in the ilium, although a little different from that in Voorhoeve's case, is quite comparable. The dense appearance of the skull and ribs is typical of osteopetrosis. The author questions whether it is possible that this increased density is due to an exaggeration of the process which caused the striation in the bones and limbs. If this is so, then his present case may represent a link between osteopathia striata and osteopetrosis, both conditions being due to the same developmental abnormality.

It is easy, according to Hurt, to suggest that there is a relationship between osteopathia striata and osteopoikilosis. Osteopathia striata may be a type of osteopoikilosis in which the striated form of lesion predominates to the exclusion of the nodular form. Some authors have maintained that the two conditions are related and that both are manifestations of the same abnormal process. It is true that the nodular areas of osteopoikilosis are prolonged in places into streaks, but these are shorter and much less regular than the dense lines seen in osteopathia striata. Hurt states that it will not be possible to give a final answer to this question of interrelationship of the three conditions until the nature of the underlying error of development is known. It may be possible that one fundamental error is common to them all.

In the article, the differential diagnosis of osteopathia striata from dyschondroplasia, Paget's disease, secondary carcinoma, Léri's melorheostosis, fluorine poisoning and syphilis is discussed.—*Ralph S. Bromer, M.D.*

Cones, D. M. T. An unusual bone tumour complicating Paget's disease. *J. Bone & Joint Surg.*, Feb., 1953, *35-B*, 101–105.

An unusual bone tumor complicating Paget's disease is described in this article. At the time of local excision of the tumor the histopathological appearance was that of a malignant osteoclastoma. The tumor rapidly recurred as a chondrosarcoma which spread locally and by metastasis. Death occurred within six months.

Since Russell (1949) drew attention to the occurrence of malignant osteoclastoma in Paget's disease, no essentially similar case was found in the literature. The case reported in this article was put on record by the author because the tumor followed an unusual course and appeared, in the first histological sections, to resemble those reported by Russell. Re-examination of these sections has allowed no alternative histopathological diagnosis to that of malignant osteoclastoma. The six months' history of the tumor, without change in size or symptoms, suggested, however, that it was benign. Transition from benign to malignant osteoclastoma was possibly taking place at about the time of operation. Certainly, according to the author, the rapid occurrence after operation suggested a malignant tumor, and the early clinical response to radiation therapy, with evidence of rapid reossification, was most unusual for a benign osteoclastoma, initial further decalcification being the more typical response. At necropsy, the sections on histopathological examination showed chondrosarcoma, and no osteoclastomatous areas were found. The lung metastases were similar in appearance.—*Ralph S. Bromer, M.D.*

Irvine, R. E. Familial Paget's disease with early onset. *J. Bone & Joint Surg.*, Feb., 1953, *35-B*, 106–112.

The author states that it is now an accepted fact that Paget's disease may run in families, though uncommonly. In this article he reports the cases of a father and two daughters. The father's case was interesting in that he developed a malignant osteoclastoma of the mandible. In the two daughters the condition was notable for the fact that in each case it began at the age of sixteen in the jaws and led to the development of osteoporosis circumscripta of the skull.

The younger sister came under observation before the other members of the family and before the osteoporosis in the cranial vault became large enough to suggest Paget's disease. The onset at eighteen years of age, the involvement of the jaws and the roentgenographic appearance in the mandible, all pointed to a diagnosis of fibrous dysplasia. The histopathological picture showed nothing that would conflict with this diagnosis. When it became clear that the patient was developing classical osteoporosis circumscripta the possibility of Paget's disease became more likely, despite the youth of the patient.

It is accepted, according to the author, that Paget's disease may exceptionally start in the twenties. He

found that familial osteoporosis is much rarer than familial Paget's disease. He thinks that Sosman (1927) was probably right when he considered that osteoporosis circumscripta represented the absorptive or destructive phase of Paget's disease with the productive stage held in abeyance. Others regard it as a localized circulatory disturbance similar to the hemorrhagic infarction of the skull described by Schmorl and stress that although it is commonest in Paget's disease it is also found in other bone dysplasias, particularly those causing proliferation of the maxilla and also in hyperparathyroidism.—*Ralph S. Bromer, M.D.*

Swain, Garrett, and Williams, Jonathan M. Eosinophilic granuloma of bone; report of a case. *J. Neurosurg.*, March, 1953, *10*, 185–188.

This is a case report of a fifty-seven year old Jewish housewife who had a history of excessive bleeding, when cut, since the age of five years, and a painful area on the vertex of the skull of one year's duration, developing shortly after several teeth were extracted. The area drained spontaneously and at the same time a draining sinus developed in the right mandible.

A biopsy of the margin of the scalp lesion was reported as chronic granulation tissue. The blood platelet count was 20,900 and the bleeding time was prolonged. Bone marrow studies showed an increased megakaryocyte count with a decreased platelet production. Roentgenograms revealed an extensive area of bone destruction in the skull with no new bone formation.

A splenectomy was done without any effect on the platelet count. Later, the massive area of destruction in the skull was removed. The histopathologic examination showed eosinophilic granuloma. About eight weeks after surgery and the insertion of a large tantalum plate, the patient received roentgen therapy, a dose of 1,350 r being given through three ports (450 r to each port). This produced some improvement but eventually the wound broke down and three months later the patient was re-admitted for removal of the plate but she stopped breathing and died apparently from uncontrollable blood loss.

This case is reported because of the association of thrombocytopenic purpura, such as is seen in Letterer-Siwe's disease with eosinophilic granuloma, and because of the large size of the lesion.—*J. M. Dell, Jr., M.D.*

Lièvre, J.-A., Verne, J.-M., and Lièvre, J.-A. (Mme.) Un type de tumeur osseuse: le neurinome parostal ossifiant. (A type of bone tumor: ossifying parosteal neurinoma.) *Presse méd.*, March 25, 1953, *61*, 441–444.

The patient, a male aged thirty-seven, reported for examination with a tumefaction of the right knee. Symptoms first appeared about eighteen months before and were considered rheumatic by the patient. They consisted of a slight discomfort on flexion, then moderate pain in the popliteal area. The first roentgenograms were made in September, 1950, nine moths before admission and they showed an opaque mass at about the lower fourth of the femur, above the knee joint. The mass was 13 by 7 cm. in size, oval in shape and wavy in outline; it was partly around and partly within the femur; and its density was irregular. In some areas the architecture was not disturbed but there seemed to be some vague longitudinal trabeculation. Above the external condyle there was a rounded linear density which seemed to outline a mass partly merging with the soft tissues. There was no evidence of bone destruction. Roentgenologically, the tumor had the appearance of an osteochondroma.

The patient received sixteen roentgen treatments over eight weeks, followed by twenty more treatments in January, 1951. The symptoms were not improved and the tumefaction seemed to increase in size. Amputation was performed in June, 1951. Histolopathologic examination revealed bone tissue and lobules of hyaline cartilage clothed in tissue which could only be of schwannian origin. The designation "ossifying parosteal neurinoma" was, therefore, applied and the tumor considered to have resulted in the formation of bone and cartilage.—*Marcy L. Sussman, M.D.*

Sassen, G. Beobachtungen einer Kombination von subchondraler Knorpelverknöcherungsstörung, Marfan-Syndrom und Dysostosis multiplex. (Studies of a combination of disturbance of subchondral ossification, Marfan's syndrome and dysostosis multiplex.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, March, 1953, *78*, 316–321.

This is a case report of a boy, aged sixteen, who showed a combination of a disturbance of ossification of some cartilaginous portions of the skeleton, Marfan's syndrome and Hurler's disease (Dysostosis multiplex).

The author cautions against the overestimation of single bony alterations, particularly in the region of the lumbar spine and pelvis for purposes of classification. A basic classification of skeletal alterations should be performed and refined by clinical studies.—*E. G. Wissing, M.D.*

Gallagher, E. J., MacGregor, M. E., and Israelski, M. Chondrodystrophy with ectodermal defects. *Arch. Dis. Childhood*, Feb., 1953, *28*, 14–18.

This is the case history of a twelve year old girl exhibiting ectodermal defects, spinal chondro-osteodystrophy of the Morquio type, and other bone and

joint deformities. The child was the daughter of unrelated parents with a normal younger sister.

She showed exaggeration of the normal spinal curvature with gross knock knee and slow and awkward gait because of stiff joints and foot deformities. The hands and forearms were deformed and the eyes were widely separated.

Roentgen examination of the spine revealed wedging of two mid-dorsal vertebrae with flattening of all of the vertebral bodies. There was irregularity of the upper and lower terminal plates and at the dorsolumbar level the typical beak-like shape of Morquio's disease was present. There was, however, a tendency to vertebral fusion which distinguishes the findings from those in ordinary Morquio's disease. The long bones showed essentially normal development except in the forearms where the bones were short and stunted. In the hands, gross developmental defects were present with short, broad, barrel-shaped metacarpals, fusion of the metacarpal bases and two carpal bones producing a large horseshoe-shaped bone. Many of the digits were webbed. The feet showed broad, short, barrel-shaped metatarsals and synostosis between the tarsal bones and the metatarsals.

Roentgenograms of the skull demonstrated it to be large with no craniostenosis. The orbits were widely separated with elevated roofs and there was a steep descent between the floors of the cranial fossae.

The authors comment upon some of the similarities of their case to others that have been reported and called the Ellis-Van Creveld syndrome. Typically the Ellis-Van Creveld syndrome shows skeletal changes consisting principally of shortening of the bones of the forearm and lower legs, shortening of the tubular bones of the hands and feet, polydactyly and massive fusion of the carpals and a normal spine.—*W. W. Maver, M.D.*

Capurro, Rafael Garcia, and Pedemonte, Pedro Victor. Hydatid cysts of the femur; total removal of the femur and replacement by a complete cadaveric femur. *J. Bone & Joint Surg.*, Feb., 1953, *35-B*, 84–88.

A case is reported of a man, aged forty-one, who complained of pain in the upper third of his left femur. Roentgenograms showed extensive changes in the shaft of the femur suggestive of hydatid cyst formation. A complete study of the patient revealed no evidence of involvement with hydatid cysts elsewhere in the body. On opening the fascia lata, a small hydatid abscess was found which clearly arose from the bone.

Wishing to avoid amputation, the possibility of total excision of the femur was considered with the substitution of an internal prosthesis which might be either an acrylic femur or a bone taken from a corpse. A femur of a young girl who had died from an accident was removed a few minutes after death with full aseptic precautions and was stored temporarily in a refrigerator. The patient was operated upon and this femur was substituted for the affected one. Ten months after operation, the patient walked confidently with a practically stiff knee and a slight limp which was partly accounted for by 3 cm. shortening in the affected leg. So far as the authors can determine, the transplanted bone is simply acting as an internal prosthesis and only time can tell if it can be considered as something more.

The article is illustrated with clinical photographs of the patient after operation, with roentgenographic reproductions of the excised femur, and of the hip and knee after operation. Several microphotographs of the biopsy of the transplanted bone are included which were made ten months after the operation. No detailed description is given in the article of the roentgenograms before operation showing the hydatid cysts.—*Ralph S. Bromer, M.D.*

General

Keasbey, Louisa E. Juvenile aponeurotic fibroma (calcifying fibroma); a distinctive tumor arising in the palms and soles of young children. *Cancer*, March, 1953, *6*, 338–346.

A microscopically distinctive type of fibroma occurring in the palms and soles of young children is described. The lesion appears to be benign, but it has a histopathological appearance of cellularity and invasiveness and tends to recur.

This tumor is observed between the ages of two and nine years. In 2 cases it arose from the thenar space, in 1 case from the hypothenar area and in 1 case from the midline of the sole of the foot. It presents as a painless, poorly circumscribed, rather fixed firm mass. It does not attach to the skin nor does it produce contractures.

Roentgenograms show a relatively radiopaque soft tissue mass with no involvement of the bone. The mass contains fine stippled areas of calcification.

Histologically, the distinctive feature is the presence of numerous, large, darkly staining, plump oval nuclei. The nuclei are somewhat vesicular in that a narrow margin of chromatin is always found beneath the nuclear membrane. Rarely, a giant nucleus is seen. Mitoses are not obvious. The nuclei are surrounded by halo-like rounded-oval cell bodies composed of clear, homogeneous cytoplasm. Reticulin is scanty. The cells are oriented in one direction. The areas of calcification are peculiar in that they give no microscopic evidence of occurring at sites of degeneration. There is a fine stippling of calcium in the cell bodies.

Following initial surgical excision, recurrences were characterized by invasion into adjacent muscle and fatty tissues.

Four cases are reported in detail and illustrated with 8 photomicrographs and 1 roentgenographic reproduction.—*I. R. Berger, M.D.*

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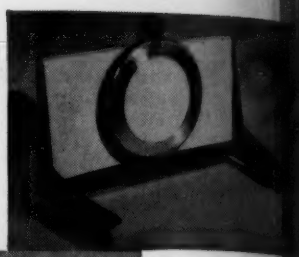

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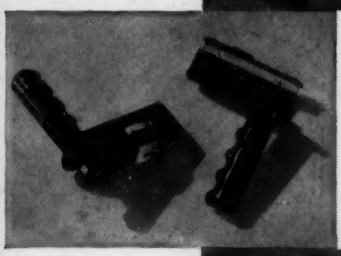

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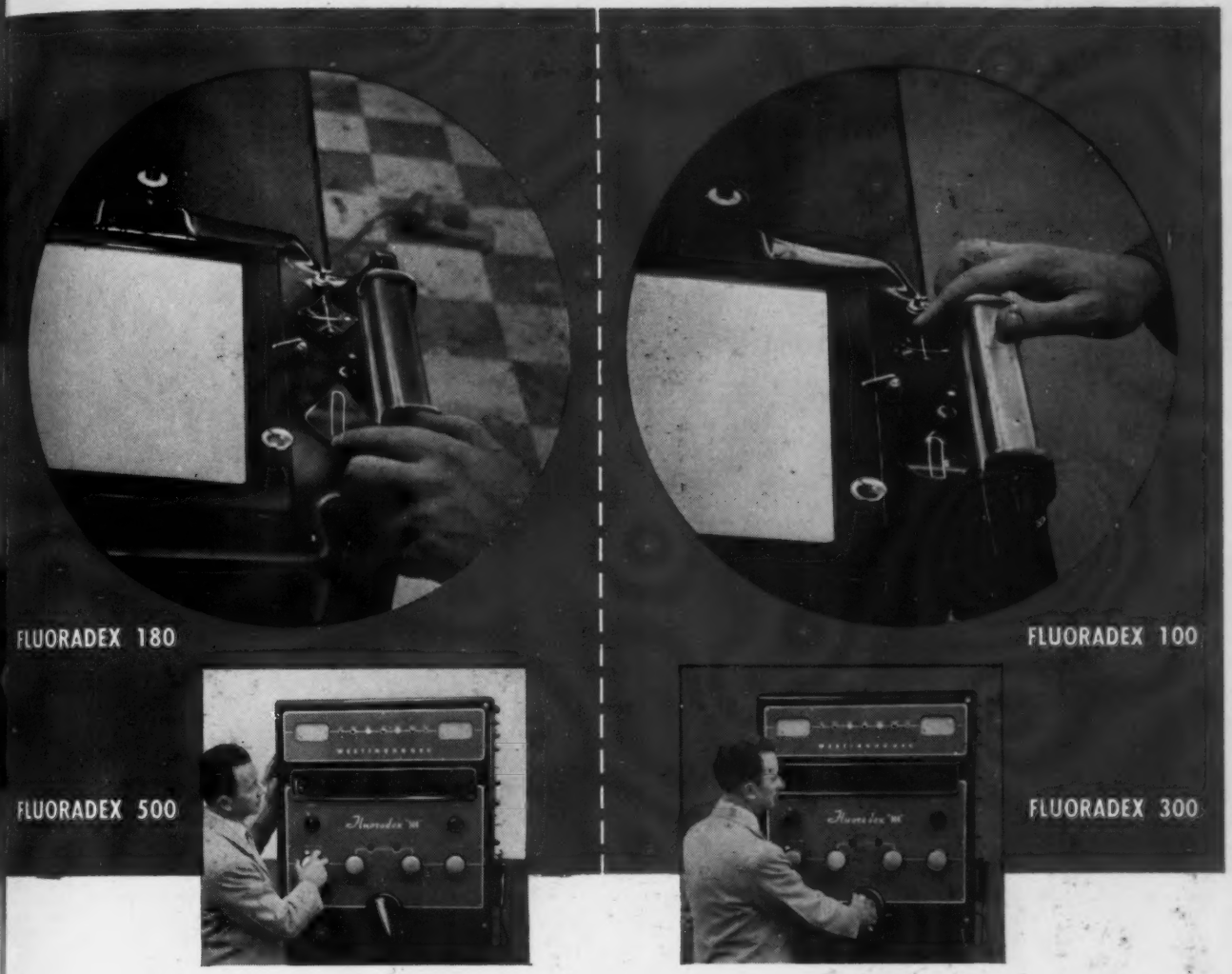

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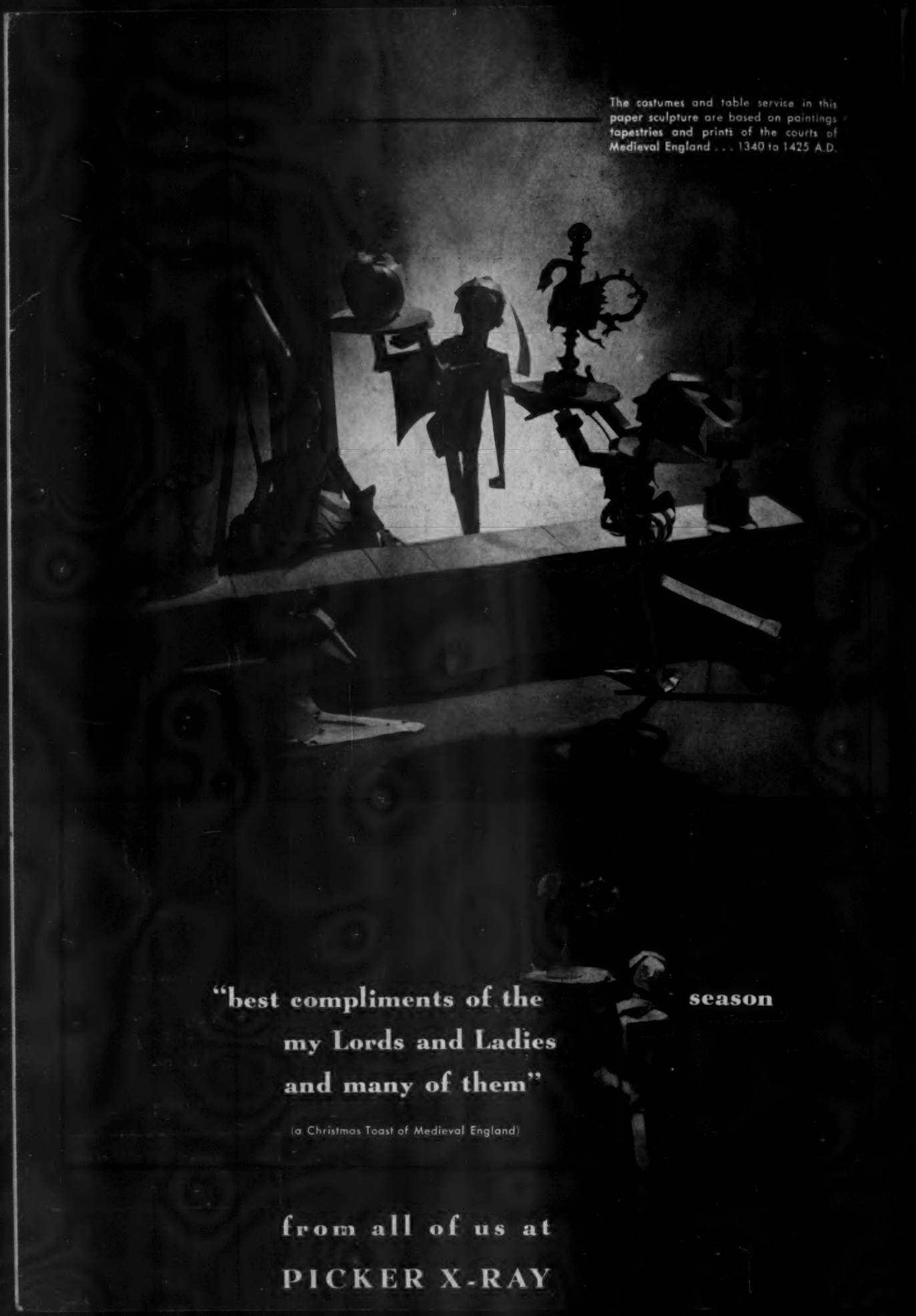
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